MONTHLY WEATHER REVIEW.

Editor: Prof. Cleveland Abbe. Assistant Editor: Herbert C. Hunter.

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The Monthly Weather Review summarizes the current manuscript data received from about 3,500 land stations in the United States and about 1,250 ocean vessels; it also gives the general results of the study of daily weather maps based on telegrams or cablegrams from about 200 North American and 40 European, Asiatic, and oceanic stations.

The hearty interest shown by all observers and correspondents is gratefully recognized.

Acknowledgment is also made of the specific cooperation of the following chiefs of independent, local, or governmental services: R. F. Stupart, Esq., Director of the Meteorological Service of the Dominion of Canada; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. I. S. Kimball, General Superintendent of the United States Life-Saving Service; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Director Meteorological Office, London; Maxwell Hall, Esq., Government Meteorologist, Kingston, Jamaica; Rev. L. Gangoiti, Director of the Meteorological Observatory of Belen College, Havana, Cuba; Luis G. y Carbonell, Director, Meteorological Service of Cuba, Havana, Cuba; Rev. José Algué, S. J., Director of the Weather Bureau, Manila Central Observatory, Philippines; Maj. Gen. M. A. Rykachef, Director of the Physical Central Observatory, St. Petersburg, Russia; Carl Ryder, Director, Danish Meteorological Institute, Copenhagen, Denmark.

As far as practicable the time of the seventy-fifth meridian is used in the text of the Monthly Weather Review.

Barometric pressures, both at land stations and on ocean vessels, whether station pressures or sea-level pressures, are reduced, or assumed to be reduced, to standard gravity, as well as corrected for all instrumental peculiarities, so that they express pressure in the standard international system of measures, namely, by the height of an equivalent column of mercury at 32° Fahrenheit, under the standard force, i. e., apparent gravity at sea level and latitude 45°.

FORECASTS AND WARNINGS.

By Prof. E. B. Garriott, in charge of Forecast Division.

IN GENERAL.

February, 1908, was unusually stormy over the eastern half of the American Continent and, as a whole, comparatively quiet from the Rocky Mountains to the Pacific coast. The temperature averaged below normal from the Mississippi River to the Atlantic, and in California and Arizona; it was above the seasonal average from the Mississippi River over the Great Plains and the Rocky Mountain, middle, and northern Plateau districts, and on the north Pacific coast. Precipitation was in excess, except in areas in the west and northwest and in the southern Rocky Mountain region. Snow was reported on the ground thruout the month in the Rocky Mountain region and from the upper Missouri Valley over New England.

Storms from the American Continent advanced over the Atlantic on the 2d, 7th, 15th, 20th–23d, and 27th, those of the last ten days of the month being the most severe in the middle and northern latitudes of the ocean. In the Iceland area the lowest barometer of the month, 28.40 inches, was reported on the 22d. Over the British Isles pressure was high during the first decade, and was generally low and fluctuating during the balance of the month. In the vicinity of the Azores the barometer continued high, except from the 10th to the 16th, when it was relatively low in that region. Over western continental Europe the barometer was low, except in the southwest, on the 1st, 4th, 15th, and 18th to 29th. In the Asiatic area winter pressure persisted, except on the 9th, 11th, 18th, and 25th, when slight depressions appeared. On the 21st and at the close of the month readings 31.00 and 31.06 inches, respectively, were reported at Irkutsk. Reports from Nome, Alaska, were missing during a great portion of the month. Over the Hawaiian Islands pressure was high, except on the 4th, 10th, and 21st, when it was slightly below normal; from the 25th to the 29th a marked depression covered that region.

The month opened with a severe storm central over Lake Huron. This storm moved over the Canadian Maritime Provinces, with reported pressure 28.84 inches at Father Point, Quebec, on the morning of the 2d, attended by gales and snow from the Great Lakes over the North Atlantic States, reached Iceland on the 6th, with pressure 29.06 inches at the morning report, and apparently past thence over Scandinavia and northern European Russia. Following this storm an area of high barometer that had covered the western half of the American Continent and adjacent portions of the Pacific Ocean moved eastward to the Atlantic coast by the 5th, attended by freezing temperatures on the middle and east coast of the Gulf of Mexico, and by killing frost in central and light frost in southern counties of Florida on the morning of the 3d.

Closely following this high area a storm crost the continent from the 2d to 7th. This storm was severe from the 4th to 6th while crossing the central valleys and the Lake region, and on the 6th and 7th was the severest storm of the month in New England. It was attended by heavy snow from the Lake region over the Middle Atlantic and New England States. Advancing over the Canadian Maritime Provinces on the 8th the disturbance reached Iceland on the 10th, and northern European Russia on the 12th and 13th. The most extensive high area of the month advanced from the Bering Sea region to the Atlantic seaboard from the 1st to 8th, attended by the lowest temperature of the season in the Middle Atlantic States, a reading of 6° being recorded at Washington, D. C., on the morning of the 9th.

Referring to the alternations of the weather during the early portion of February the Buffalo, N. Y., News, of February 6, remarks, editorially, as follows:

> Leaving out of account the present storm as something not yet ready for the record it will be admitted on the face of the returns that western New York has had a spell of weather in the last few days. The wit who said the weather had gone into vaudeville failed only to take into his tally the tragedy of blizzards and Arctic waves. In the past two weeks cold waves, snowstorms and high winds, and gales have followed each other in rapid succession and Buffalo has had more than her share of the snow, about 26 inches having fallen during Saturday, Sunday, and

Monday, with zero temperature accompanied by winds with almost hurricane force, a velocity of 76 miles an hour being reached February 1. These conditions have called for special caution on the part of shippers of perishable goods, railroads, and the traveling public; and the warnings from the Weather Bureau have amply served to prepare all concerned for the changes in advance of their coming. Each important characteristic of weather conditions has been heralded at least thirty-six hours in advance, thereby saving much property and probably many lives. * * The local Weather Bureau office has performed a signal service during the past severe weather. Its predictions of the big storms of last week and this have been well worth all the Bureau costs in a year.

The third barometric depression of the month moved slowly from the Pacific to the Atlantic coasts from the 8th to 15th, attended by mild temperature and heavy rains that resulted in floods in the central valleys and the Eastern States. Crossing the Canadian Maritime Provinces during the 16th this depression entered an extensive low barometer area that covered the higher latitudes of the north Atlantic Ocean from the 18th until the close of the month. During the passage of this disturbance over the interior of the United States tornadic storms were reported on the 14th in Texas and Mississippi, and severe windstorms were experienced on the Lakes and Atlantic coast during its passage over the eastern districts. From the 16th to 20th a disturbance crost the American Continent, attended by heavy snow and gales from the upper Mississippi Valley eastward, and followed by a moderate cold wave that carried the line of frost to the middle Peninsula of Florida. From the 23d to 26th a barometric depression advanced from the British Northwest Territory to the Atlantic coast with general precipitation from the Rocky Mountains eastward and gales on the Great Lakes and the Atlantic and Gulf coasts. This depression was followed by a cold wave that produced the lowest temperatures of the season in southeastern Florida, freezing temperature being reported in Dade County on the 28th.

During the closing days of the month barometric pressure decreased over the western portion of the United States, and by the 29th unsettled weather had set in generally thruout the central valleys and thence westward to the Pacific coast.

BOSTON FORECAST DISTRICT.*

[New England.]

The month as a whole was cold and stormy. The coast was swept by several severe storms, the most severe of which was the one of the 6–7th. There was considerable snow in the first decade, and the minimum temperatures of the month occurred generally on the 5th. While there was much delay and inconvenience to shipping from stress of weather, there was no great damage to vessels or to shore property.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.*

[Louisiana, Texas, Oklahoma, and Arkansas.]

Precipitation was generally excessive and temperature as a rule above the normal. No extensive cold wave occurred and no general storm visited the Gulf coast. Frost or freezing temperature warnings were issued for all injurious temperature conditions.—*I. M. Cline, District Forecaster.*

LOUISVILLE FORECAST DISTRICT.*

[Kentucky and Tennessee.]

The month was stormy, with an excess of precipitation and no very cold weather. Cold-wave warnings were ordered on the 1st in advance of the cold weather of the first three days, when the lowest temperature of the month occurred.—*F. J. Walz, District Forecaster.*

CHICAGO FORECAST DISTRICT.*

[Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, and Montana.]

No sweeping cold waves occurred. Advisory messages for high winds were issued to open ports on Lake Michigan. No Lake casualties have been reported. The principal feature of the weather conditions in the district was the occurrence of heavy rains and snows attending the movement of four different storms, the most severe of which occurred in the latter part of the second decade of the month. Warnings were issued in advance of these storms as far as possible, and it is thought that the forecasts were of great service.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.*

[Wyoming, Colorado, Utah, New Mexico, and Arizona.]

There were a few cold snaps of brief duration and heavy snowfalls of a local character, but the prevailing weather was fine—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.†

[California and Nevada.]

The month as a whole was one of pleasant weather, with a normal amount of rain. During the middle of the month the weather was generally clear and pleasant owing to the existence of a marked high area. Some moderately heavy frosts occurred and ample warnings were issued in all cases. The month closed with a severe storm.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.†

[Oregon, Washington, and Idaho.]

The month was unusually quiet and only two storms of note crost the district, one on the 5th and the other on the 26th. Timely warnings were issued. No cold waves occurred.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

Winter and spring storms from the southwest that move northeastward from New Mexico and Texas thru the Ohio Valley, the lower Lake region, and the St. Lawrence Valley are usually attended by heavy rains and abnormally high temperatures over the east and south quadrants. These rains almost invariably cause severe floods in the rivers, particularly in the Ohio and its tributaries, and they are frequently much increased in magnitude by the additional volume of water from the melting of the snows that have accumulated since the last thaw. In fact it often happens that the melting of the accumulated snow contributes more to the flood volume than does the rainfall resulting from the storms.

The storm of February 13–16, 1908, was no exception to the general rule. On the night of February 10 there were from 3 to 18 inches of snow over the upper Ohio watershed with a water equivalent of about 20 per cent of the actual depth, the greatest amount being over the Allegheny River watershed. This snow began to melt on the 12th, under the influence of warm southerly winds caused by a depression to the northwestward, and preliminary advices were issued on that day from the Central Office at Washington to the effect that warm rains would cause rapid melting of the snows over the upper Ohio Valley and the Middle Atlantic States with a probability of high waters and the breaking up of ice.

Specific warnings from the district centers began on the 13th and 14th, and during the 15th they were extended to the Atlantic coast.

To give in detail the history of the floods would simply mean a repetition of the history of past floods with the single, altho extremely significant, exception that never before had a flood of such magnitude prevailed over the Ohio Valley without loss of human life, and with so little loss and damage to property. It was freely admitted in this connection that this happy condition of affairs had been made possible by the timely and accurate warnings of the Weather Bureau. Practically nothing movable was damaged, but the damage to what could not be moved amounted to several millions of dol-

* Morning forecasts made at district center; night forecasts made at Washington, D. C.

† Morning and night forecasts made at district center.

lars, Pittsburg alone suffering to an amount variously estimated at from one to three millions.

Flood stages were first reached on the lower Mississippi on the 21st, but at the end of the month the flood line had not been reached at Greenville, Miss., while the crest had just past New Madrid, Mo.

Following are the flood and crest stages at the various stations of observation from Pittsburg to Cairo, with the dates of the crests:

Station.	Flood stage.	Crest stage.	Date.
	Feet.	*Feet.*	
Pittsburg, Pa	22	30.7	16
Beaver Dam, Pa	27	41.3	16
Wheeling, W. Va	36	42.8	17
Parkersburg, W. Va	36	41.2	18
Point Pleasant, W. Va	39	45.7	19
Huntington, W. Va	50	48.1	19
Catlettsburg, Ky	50	49.2	19
Portsmouth, Ohio	50	50.9	19
Maysville, Ky	50	48.9	20
Cincinnati, Ohio	50	51.3	20
Madison, Ind	46	41.5	21
Louisville, Ky	28	24.7	21
Evansville, Ind	35	40.9	23, 24
Mount Vernon, Ind	35	41.3	25
Paducah, Ky	40	40.9	26
Cairo, Ill	45	44.9	26

The Wabash River reached a stage of 18.9 feet at Terre Haute, Ind., on the 20th, 2.9 feet above flood stage, and 23.2 feet at Mount Carmel, Ill., on the 24th, 8.2 feet above flood stage. Excellent warnings were also issued for the interior rivers of Ohio, and they were of great value to all concerned.

No damage of consequence was caused by the flood in the Illinois River, altho the crest stages were from 3 to 7 feet above the flood line. Warnings were issued on the 13th and 14th.

Nearly all of the rivers of the Middle Atlantic States and New England were in flood on the 16th and 17th, accompanied by the breaking up of the ice, but as warnings had been given a few days in advance, the damage was reduced to a minimum.

Flood stages also occurred in most of the rivers of the South Atlantic and east Gulf States, but without unusual incident, as warnings were issued at the proper time. These warnings were of special value to the cattle and lumber interests. The greatest rises occurred in the rivers of Alabama.

By the end of the month normal conditions had been resumed, except in the lower Ohio, lower Mississippi, Illinois, and Wabash rivers, where high stages continued.

On February 4 the first warning was issued for the Gila River of Arizona, and altho no flood was anticipated, the warnings of a moderate rise in the lower river were of value.

ICE.

At the end of the month the Mississippi River was frozen over almost as far south as Davenport, Iowa, which was about the southern limit at the end of February, 1907. It had been frozen over as far as Hannibal, Mo., but opened on the 14th at Davenport, on the 25th at Muscatine, Iowa, and on the 12th at Hannibal. Floating ice was observed early in the month as far south as New Madrid, Mo.

The Missouri River remained closed as far down as Sioux City, Iowa, and for some distance below. It had been closed at Omaha, Nebr., but opened on the 12th. There were occasional gorges below early in the month, and navigation in and out of Hermann, Mo., was suspended from the 1st to the 10th inclusive.

The Ohio River remained open, altho floating ice was frequently observed during the first half of the month.

The middle Atlantic and New England rivers were generally frozen at the beginning of the month, but the thaw of the 13th and 14th broke up the ice except in eastern New England.

The southernmost point from which ice was reported was Weldon, N. C., on the Roanoke River, where floating ice was observed from the 3d to the 6th, inclusive.

SNOW.

The following information has been condensed from the snow bulletins issued in the Western States, where the water supply for irrigation purposes is dependent upon the amount of run-off from melted snow.

Arizona.—There was much more snow than the combined fall of the two previous months; the snow is well packed, and the prospects of a plentiful water supply are now very favorable.

Colorado.—Over the northern watersheds the snowfall was deficient, but over the southern portion it was, as a whole, in excess of the normal amount. Conditions appear to indicate an early flow of water, with a deficient supply over the central and northern portions of the State.

Idaho.—The greater portion of the snow fell over the northern end of the State, where the fall had hitherto been deficient. The snow is compact, and an average flow of water is indicated, except in the Wood, Boise, and Salmon River districts.

Montana.—Altho there was a material increase in the snowfall, the flow of water for navigation and mining purposes will be inadequate.

Nevada.—There was a general increase in the depth of accumulated snow, but without exceptionally favorable conditions in March, the flow of water will be deficient.

New Mexico.—Conditions on the whole are fairly favorable, except over the Canadian watershed, and the extreme southwestern portion of the territory.

Utah.—While the snowfall for February was deficient, yet that left on the ground is well packed and prospects of a good water supply are favorable. The lakes and streams are high for the season.

Oregon.—There is much less than the usual amount of snow on the ground, owing both to deficient supply and the excess of rain. The run-off will consequently be less than usual.

California.—A good supply of water is indicated.

Washington.—The winter snow has thus far been deficient, and the flow of water will probably fail to meet all requirements.

Wyoming.—The snowfall of the month was light, but what remains is well packed, and a good supply of water is indicated, except possibly over the eastern slope of the Big Horn Mountains, where more snow is needed.

The highest and lowest water, mean stage, and monthly range at 207 river stations are given in Table IV. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

SPECIAL ARTICLES, NOTES, AND EXTRACTS.

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

H. H. KIMBALL, Librarian.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——

American aeronaut. St. Louis. v. 1. Feb.-Mch., 1908.
Clayton, Henry Helm. The use of air currents in ballooning. p. 111-115.
American philosophical society. Proceedings. Philadelphia. v. 46. Oct.-Dec., 1907.
See, T. J. J. The new theory of earthquakes and mountain formation, as illustrated by processes now at work in the depths of the sea. p. 369-416.
India. Meteorological department. Memoirs. Calcutta. v. 18, pt. 3.
Eliot, Sir John. A discussion of the anemographic observations recorded at Lucknow from July, 1878, to October, 1892. p. 373-430. [Includes description of the climate.]
Eliot, Sir John. Discussion of the anemographic observations recorded at Allahabad from September, 1890, to August, 1904. p. 283-371. [Includes description of the climate.]
Nature. London. v. 77. March 5, 1908.
Evans, J. W. The possibility of life on Mars. p. 413.
Popular astronomy. Northfield, Minn. v. 16. Mch., 1908.
Sperra, William E. A night mirage. p. 164-167.
Royal meteorological society. Quarterly journal. London. v. 34. Jan., 1908.
Dines, W. H., and others. The international balloon ascents, July 22-27, 1907. p. 1-14. [Contents: I. The registering balloon ascents in England of July 22-27, 1907; preliminary account. II. Results of the balloon ascents made from Manchester, July 22-28, 1907. III. Balloon experiments in Dublin, July 22-27, 1907.]
—— The dispersal of fog. p. 14. [Note on proposed experiments by Maggiora in London.]
White, Margaret, and others. Discussion of the meteorological observations at the British kite stations, 1906-1907. p. 15-25.
—— Audibility of clock bells. p. 26.
—— Influence of temperature on the iron railway viaduct at Crumlin. p. 26.
—— The Furness railway wind gage.
Ley, C. H. The possibility of a topography of the air based on balloon observations with special theodolites. p. 27-45.
—— Dust devil. p. 45-46.
Strachan, Richard. Indications of approaching frost. p. 47-50.
Science. New York. New series. Mch. 6, 1908.
Schaeberle, J. M. The earth as a heat-radiating planet. p. 392-393.
South African philosophical society. Transactions. Cape Town. v. 18, pt. 3, 1907.
Sutton, J. R. On the lunar cloud period. p. 313-320.
Symons's meteorological magazine. London. Feb., 1908.
Boeddicker, Otto. Black rain in Ireland, October 8-9, 1907. p. 2-4.
Terrestrial magnetism and atmospheric electricity. Baltimore. v. 12. Dec., 1907.
Keeling, B. F. E. Helwan magnetic observatory, Egypt. p. 149-152.
Tittman, O. H. Results of magnetic observations made by the United States coast and geodetic survey at the time of the total solar eclipse of August 30, 1905. p. 153-160.
Everdingen, E. van. The life and work of Maurits Snellen. p. 165-168. [With portrait.]
Schmidt, Adolf. Die magnetischen Observatorien des preussischen meteorologischen Instituts. p. 169-174.
Fleming, J. A. Mean values of the magnetic elements at observatories. p. 175-182. [Gives data for 60 stations.]
Ciel et terre. Bruxelles. 28 année. 16 fév. 1908.
L., E. La trombe du lac de Zug et les trombes. p. 590-599. [Abstract of paper by Früh.]
Rahir, E. Étude des crues et de la température à l'intérieur de la nouvelle grotte de Dinant. p. 590-599.
—— Discours prononcés aux funérailles de M. A. Lancaster, par MM. Mourlon, membre de la Classe des sciences de l'Académie royale; Goedseels, administrateur-inspecteur de l'Observatoire royal; J. Vincent, météorologiste à l'Observatoire royal; G. Lecointe, directeur du Service astronomique, et E. Lagrange. p. 577-589.
France. Académie des sciences. Comptes rendus. Paris. Tome 146.
Bigourdan, G. Sur les principaux centres de tremblements de terre du sol de la France, et sur le réseau des stations sismiques qu'il conviendrait d'établir. (20 jan. 1908.) p. 97-98.
Féry, C., and Millochau, G. Contribution à l'étude du rayonnement calorifique solaire. (3 fév. 1908.) p. 252-254.
Rozet, Cl. Sur la relation entre les ombres volantes et la scintillation. (17 fév. 1908.) p. 325-327.
Nature. Paris. 86 année. 8 fév. 1908.
Troller, A. La résistance de l'air. p. 145-147. [Account of Eiffel's experiments.]
Société belge d'astronomie. Bulletin. Bruxelles. 13 année. Jan., 1908.
L., E. Tremblements de terre et phénomènes météorologiques. p. 44-45. [Note on rain following earthquakes in Chili.]
Annalen der Hydrographie und maritimen Meteorologie. Berlin. 36 Jahrgang. 1908.
Köppen, W. Die Windrichtung in 800 Drachenaufstiegen und 44 "Abreissern" bei Hamburg, 1903-1906. p. 49-63.
Schlenzka, S. Fesselballonaufstiege für meteorologische Höhenforschung an Bord S. M. S. "Planet." p. 63-66.
Schneider, J. Ueber die Änderungen der meteorologischen Elemente zu Hamburg unter dem Einfluss des Mondes. p. 66-71.
K., E. Der Batticaloa-Orkan vom 9. März 1907. p. 83-85.
Lütgens, Rudolf. Die Erklärung der Mistpoeffers oder Nebelknalle. p. 87-88.
Beiträge zur Geophysik. Leipzig. 8. Bd.
Davison, Charles. The relative velocities of earthquake waves and earthquake-sound waves. p. 1-6.
Davison, Charles. The effects of an observer's condition on his perception of an earthquake. p. 68-78.
Rudolph, E. Ostasiatischer Erdbebenkatalog. Verzeichnis der im Jahr 1904 auf den Erdbebenstationem in Japan, Formosa, Manila und Batavia registrierten Störungen. p. 113-218.
Hobbs, William Herbert. On some principles of seismic geology. p. 219-292.
Hobbs, William Herbert. The geotectonic and geodynamic aspects of Calabria and northeastern Sicily. A study in orientation. p. 293-362.
Kövesligethy, R. v. Seismischer Stärkegrad und Intensität der Beben. p. 364-366.
Kövesligethy, R. v. Vorläufige Elementenbestimmung des Cerambebens. p. 400-451.
Fuchs, Karl. Freie Schwingungen der Erde. p 486-493.
Baumgärtel, Bruno. Ueber eine in der Gegenwart andauernde Erdbewegung. p. 494-498.
Kühl, Wilhelm. Der jährliche Gang der Bodentemperatur in verschiedenen Klimaten. p. 499-564.
Spitaler, Rudolph. Die jährlichen und periodischen Änderung der Wärmeverteilung auf der Erdoberfläche und die Eiszeiten. p. 565-602.
Beiträge zur Geophysik. Leipzig. 9. Band.
Strassburg, K. Haupstation für Erdbebenforschung. Jahresbericht des Direktors der Kaiserl. Haupstation für Erdbebenforschung für das Jahr 1906. p. 140.
Harboe, E. G. Das Erdbeben von Belluno am 29. Juni 1873. p. 96-104.
Harboe, E. G. Das Erdbeben von Charleston am 31. August 1886. p. 105-110.
Berliner Zweigverein der Deutschen meteorologischen Gesellschaft. Jahresbericht. 1907.
Kassner, C. Die Lufttemperatur bei Schnee- und Graupelfall in und um Berlin. p. 13-34.
Gaea. Leipzig. 44. Jahrgang. 1908. März.
—— Die moderne Seenforschung in ihrer Beziehung zu klimatologischen Problemen. p. 155-163. [Abstract of paper by Halbfaass.]
—— Die Verteilung der Temperatur in der Atmosphäre am nördlichen Polarkreis und in Trappes. p. 166-169.
—— Die Wasserhose auf dem Zugersee am 19. Juni 1905. p. 169-170.
Meteorologische Zeitschrift. Braunschweig. Band 25. Feb., 1908.
Kassner, C. Meteorologische Erdgloben. p. 49-52.
Kähler, Karl. Flächenhelligkeit des Himmels und Beleuchtungsstärke in Räumen. p. 52-57.
Exner, Felix M. Ueber eine erste Annäherung zur Vorausberechnung synoptischer Wetterkarten. p. 57-67.
Wegener, Kurt. Ueber die zweite Fahrt des Ballons "Ziegler" nach England vom 1. bis 3. November 1907, in 40 Stunden. p. 67-73.
Börnstein, R. Zur Geschichte der hundertteiligen Thermometerskala. p. 73-76. [Repr. Physik. Zeit.]
Liznar, J. Ueber eine Abänderung des Fortinschen Barometers. p. 76-78.
—— Bodenbewegungen und Barometerschwankung. p. 79.
Bauer, L. A. Die Beziehungen zwischen potentieller Temperatur und Entropie. p. 79-82.
Defant, A. T. Okada über den täglichen Wärmeaustausch in einer Schneedecke. p. 82-85.
Exner, F. M. Messungen der Intensität der Sonnenstrahlung in Warschau von Ladislaus Gorczynski. p. 85-87. [Abstract.]
—— Resultate der meteorologischen Beobachtungen zu Cuyabá im Jahre 1906. p. 87.
D., A. T. Okada: Föhnwinde zu Wosan in Korea. p. 88.
Woeikow, A. Klima von La Paz, Bolivien. p. 91. [Abstract of paper by Rudaux.]
Wetter. Berlin. 45. Jahrgang. Jan., 1908.
Börnstein, R. Die Förderung der Wettervorhersagung durch das Beobachten kleiner Luftballons. p. 2-6.
Schulze, Paul. Ludwig Friedrich Kämtz. p. 6-9.
Meissner, Otto. Der Einfluss der Windrichtung auf die Bewölkung in Potsdam (1894-1900). p. 9-13.
Klengel, Friedrich. Die Niederschlagsverhältnisse von Deutsch-Südwestafrika. III. Die aperiodischen Schwankungen des Niederschlages. p. 13-17.
Wiener Luftschiffer-Zeitung. Wien. 7. Jahrgang. Jan., 1908.
König, Roman. Zum "Windschlag." p. 16-17.

Reale accademia dei Lincei. Atti. Roma. v. 17. 1. sem. Fasc. 3.
Trabacchi, C. C. La dispersione elettrica in un luogo sotterraneo chiuso. p. 106-107.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

H. H. KIMBALL, Librarian.

The following titles have been selected from among the books recently received, as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies. Most of them can be loaned for a limited time to officials and employees who make application for them. Anonymous publications are indicated by a ——.

Akerblom, F.
Recherches sur les courants les plus bas de l'atmosphère au dessus de Paris. Upsala. 1908. 45 p. 4° (Nova acta Regiae societatis scientiarum Upsaliensis. Ser. 4. Vol. 2. N. 2.)

Batavia. Royal magnetical and meteorological observatory.
Observations made at the . . . Vol. 28, 1905. Batavia. 1907. xxxvii, 198 p. f°.
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NOTES FROM THE WEATHER BUREAU LIBRARY.

By C. FITZHUGH TALMAN, Assistant Librarian.

THE KITE STATION ON LAKE CONSTANCE.

Das Weltall for February 15, 1908, contains an illustrated description of the kite station at Friedrichshafen, on Lake Constance, which is to be opened April 1 of this year. This station was established and is to be maintained at the joint expense of the German Empire and the States of Bavaria, Württemberg, Baden, and Alsace-Lorraine, but will be attached especially to the meteorological service of Württemberg. An important part of its equipment is a small steamboat, the *Gna*, which will be used to lift the kites in calm or stormy weather. In the latter case the steamer will run with the wind, thus moderating its effect upon the kite. As Lake Constance is not far from the first-order meteorological station at the top of the Säntis, a good opportunity will be afforded to compare observations at a mountain station with those made in the free air at a similar altitude.

The establishment of this new station is a fresh proof of the great interest taken in upper air research by the German imperial and state governments, which already maintain the most complete aeronautical observatory of the world, at Lindenberg, Prussia, the kite station of the Deutsche Seewarte,

at Gross-Borstel, near Hamburg, and institutions for upper air research at Strassburg (the headquarters of the International Committee for Scientific Aeronautics) and at Munich.

ALBERT LANCASTER (1849–1908).

M. Albert Benoît Marie Lancaster, Director of the Meteorological Service of Belgium, died at Brussels February 4, 1908. He was born at Mons, Belgium, in 1849; accompanied Houzeau, then director of the Royal Observatory of Belgium, to Texas to observe the transit of Venus in 1882, and was associated with Houzeau, in producing the great "Bibliographie Générale de l'Astronomie" and a popular treatise on meteorology. He was one of the founders of the fortnightly journal of astronomy and meteorology, Ciel et Terre, and for many years its principal editor. Besides numerous contributions to the scientific journals, he published an important collection of rainfall statistics for Belgium, "La pluie en Belgique" (Brussels, 1894). In 1903 Lancaster succeeded Snellen as a member of the International Meteorological Committee.

J. Vincent succeeds Lancaster, provisionally, as director of the Belgian service.

A NEW METEOROLOGICAL BULLETIN FROM BOLIVIA.

The Weather Bureau Library has received the first number of the "Boletín mensual del Servicio Meteorológico de la República Boliviana," issued by the Meteorological Observatory of La Paz, under the direction of the Bolivian Ministry of Colonization and Agriculture. The title of this publication is somewhat misleading, as the data contained relate solely to observations at La Paz. These are, however, published in much detail, and the editor of the bulletin states, in his introduction, that he will be glad to receive and publish meteorological observations from the agricultural "juntas," established in the several departments of the country, as well as from individuals interested in meteorology. It is to be hoped that this suggestion will be heeded, as but few statistics now exist concerning the climate of Bolivia, outside of La Paz.

THE LATE SIR RICHARD STRACHEY.

Lieut. Gen. Sir Richard Strachey, R. E., G. C. S. I., LL. D., F. R. S., died February 12, 1908, in his ninety-first year. A long and appreciative review of his career, by Mr. W. N. Shaw, who was intimately associated with him for many years in the administration of the British Meteorological Office, appears in Nature of February 27.

General Strachey's earlier scientific work was done in India. As head of the Public Works Department he had much to do with the creation and development of the admirable Indian meteorological service, and as president of the Famine Commission he investigated the physical causes of Indian famines. He also studied the physical geography and meteorology of the western Himalaya and Tibet. Some of the other subjects which engaged his attention during his long career were the relation of rainfall at Madras to the sun-spot period, the vertical distribution of aqueous vapor in the atmosphere, the barometrical disturbances and sounds produced by the eruption of Krakatoa, meteorological applications of the harmonic analysis, and the computation of mean daily temperatures and of accumulated temperatures, in connection with the latter of which he suggested the use of the term "day-degrees."

In 1884 he represented Great Britain at the Prime Meridian Conference at Washington. In 1873 he became a member of the meteorological committee of the Royal Society, later known as the Meteorological Council, and in 1883 its chairman, a post which he held until the council ceased to exist in 1905.

In 1906 he received the Symons Memorial Gold Medal of the Royal Meteorological Society.

A METEOROLOGICAL SERVICE IN FRENCH WEST AFRICA.

For many years the Central Meteorological Bureau of France has published in its annals the results of meteorological observations at a few widely scattered stations in French West Africa. One station, Gorée, was established as early as 1840. In 1903, after the consolidation of the colonies of French West Africa under a single administration, a local meteorological service was inaugurated, on the model of that which has existed for a number of years in French Indo-China, the director of the colonial medical service being placed at its head. Besides taking over the control of the old stations in this region, several new stations were established, and uniform methods of observation were adopted. Professor Mascart rendered valuable counsel and assistance in this undertaking.

At the end of 1905 the following stations were in operation: Dakar, St. Louis, and Sédhiou, in Senegal; Kaëdi, Tidjikdja, Boutilimit, Nouakchout and Mal, in Mauretania; Ségou, Bobo-Dioulasso, Kati, Sikasso, Gaoua, Bandiagara, and Kouri, in Upper Senegal and Niger; Timbuktu, Niamey, Zinder and Dori, in the "territoire militaire"; Konakri, Beyla, Kissidougou, Kouroussa, Kindia, Dittinn, and Touba, in French Guinea; Grand Bassam, Toumodi, Dabakala-Koroko, Séguela, and Bouaké, in the Ivory Coast colony; and Porto Novo and Parakou in Dahomey.

A history and description of the new service, together with pressure, temperature, humidity, and rainfall curves for certain stations for 1904 and 1905, was published in pamphlet form by the government of French West Africa, 1906, in connection with the colonial exposition at Marseille. A copy of this publication has recently been received in the Weather Bureau Library.[1]

THE WRECK OF THE AUSTRAL.

The Scottish Geographical Magazine reports the wreck of the *Austral*, the vessel recently sent out by the Argentine Meteorological Office to establish a meteorological station on Wandel Island. The valuable meteorological instruments were lost, and the establishment of the station will be delayed at least a year. This is to be one of several Argentine stations, some of which are already in operation, in the island groups to the southeast of the continent of South America. The *Austral* was formerly the *Français*, of Dr. Charcot's antarctic expedition.

METEOROLOGICAL CABLEGRAMS FROM ICELAND.

Nearly all the meteorological services of Europe, except France, now receive direct daily weather reports by cable from Iceland and the Faroes, each paying therefor an annual subscription of $1,200. Owing to the limited funds at its disposal, the French service is obliged to depend upon the British weather map for its reports from these islands, an arrangement that entails a delay of twenty-four hours and makes the reports practically useless for forecasting purposes. This matter was brought to the attention of the French Academy of Sciences at the meeting of January 6, 1908, and a resolution was past urging the government to make suitable provision for obtaining these reports by cable.

HODGKINS FUND PRIZE.

In connection with the International Congress on Tuberculosis, to be held in Washington September 21 to October 12, 1908, the Smithsonian Institution offers a prize of $1,500 from the Hodgkins Fund for the best treatise on the relation of atmospheric air to tuberculosis. Memoirs having relation to the cause, spread, prevention, or cure of tuberculosis are included within the general terms of the subject. The language may be English, French, German, Italian, or Spanish, and papers will be received until October 12, 1908.

The Hodgkins Fund, established in 1891, is devoted to "the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man." Liberal prizes are offered from time to time, and each competition is sure to bring out some notable contributions to science. An award of $10,000 from

[1] Gouvernement général de l'Afrique Occidentale Française. Notices publiées par le gouvernement général à l'occasion de l'exposition coloniale de Marseille. Service météorologique. Paris: É. Larose. 1906. 54 p. 8°.

this fund was made to Lord Rayleigh and Professor Ramsay for their discovery of argon and their memoir on the subject.

DOCTOR POLIS'S VISIT TO AMERICA.

Dr. P. Polis, the well-known director of the Meteorological Observatory of Aachen (Aix-la-Chapelle) has prepared a report of his official visit to the meteorological institutions of the eastern United States and Canada, carried out in the autumn of 1907, and it has been published in the form of a handsome octavo pamphlet under the auspices of the German Ministry of the Interior.[2]

Numerous illustrations, as well as reproductions of weather maps, bulletins, etc., are included in the volume, which has appeared with remarkable expedition, considering the elaborate character of the report.

Doctor Polis visited the Weather Bureau stations at Atlantic City, Buffalo, Boston, New York, and Pittsburg; the central office of the Meteorological Service of Canada, at Toronto; the meteorological observatory at McGill University, Montreal; Harvard University; the Blue Hill Observatory; and the research observatory of the Weather Bureau at Mount Weather; and finally spent a month at the Central Office of the Weather Bureau in Washington. Before sailing for Germany he attended the Aeronautical Congress in New York.

Doctor Polis's journey was undertaken especially with a view to obtaining suggestions useful to the new public weather service of Germany, of which he is an official.

A METEOROLOGICAL ALMANAC FROM BELGIUM.

M. Albert Bracke, of Mons, Belgium, is actively engaged in the "vulgarization" of meteorology (to use the French expression), by means of numerous and varied publications; viz, "La Revue Néphologique," a unique periodical devoted to the study of clouds; "Curiosités de l'Atmosphère," a series of brochures devoted to miscellaneous meteorological topics, of which eight numbers have appeared; "Publications de la Station Météorologique de Mogimont," devoted more especially to the investigation of Belgian thunderstorms; besides a great number of occasional publications. M. Bracke is, in fact, one of the most prolific writers in the domain of popular meteorology.

One of the latest enterprises of this writer is a meteorological almanac, published as an adjunct to the semi-monthly aeronautical publication, "La Conquête de l'Air," and known as "Almanach de la Conquête de l'Air," of which the volume for 1908 has recently been issued. This publication includes blank forms upon which the amateur meteorologist may record his observations from day to day; tables of daily normal temperatures for Brussels; the weather folk-lore of each month of the year; a chronicle of weather happenings in Europe during the preceding year (in the manner of the popular weather chronicles of our forefathers; a *genre* now rather too rare in meteorological literature); and numerous little articles on meteorological topics, of which we have space to mention only an illustrated account of Flammarion's private observatory at Juvisy.

A MODEL METEOROLOGICAL SERVICE IN SOUTH AMERICA.

An interesting exception to the general neglect of meteorology in South America is the state of São Paulo, in Brazil, which possesses an official meteorological service not inferior to the average of those of Europe, and a greater number of stations per unit area, as well as a much larger percentage provided with self-recording instruments, than even the well-known service of the Argentine Republic.

São Paulo is one of the richest of the Brazilian states and the greatest producer of coffee, exporting thru its chief port, Santos, more coffee than any other district in the world. There is a large German population; a fact that probably accounts for the amount of attention paid here to meteorology and other sciences.

The meteorological service began in 1887 with two stations, and has steadily grown, thanks to the untiring efforts of its successive directors, Derby, Loefgren, and Belfort Mattos. The central office is at São Paulo, the capital of the state, and has a staff comprising a director, assistant director, and five meteorologists. The other stations are mainly in the charge of school teachers, telegraph officials and engineers, who are paid small stipends for their meteorological work. Observations are taken at 7 a. m., 2 p. m., and 9 p. m. Nearly half the stations are supplied with self-recording barometers, thermometers, anemometers, and rain gages of the latest pattern. Stations have not yet been established in the western part of the state, which is still a wilderness, inhabited mainly by Indians.

The climatic data collected by this service were utilized by E. L. Voss, a former official of the service, in the elaboration of his extensive work on the climate of the southern States of Brazil, as well as in his more recent work on the rainfall of South America; published as "Ergänzungshefte" Nos. 145 and 157, respectively, to Petermanns Geographische Mitteilungen (Gotha, 1903 and 1907).

The meteorological service of São Paulo is known officially as the "Meteorological Section of the Directory of Agriculture," having been transferred last year from the State Geographical and Geological Commission. In consequence of this transfer a new series of its quarterly bulletin, "Dados Climatologicos," has just begun.

NECROLOGY.

Lieut.-Col. R. L. J. Ellery, C. M. G., F. R. S., a well-known Australian meteorologist and astronomer, died January 16, 1908. Colonel Ellery was for many years director of the Melbourne observatory and government astronomer of Victoria, and as such the official head of meteorology in that colony. He was president of the Royal Society of Victoria for twenty-three years.

Alexander Faber, owner and publisher of a leading daily newspaper in Magdeburg, Germany, the Magdeburgische Zeitung, died February 2, 1908, in his sixty-fourth year. In connection with his paper he maintained, from 1880, a well-equipped meteorological observatory, known as the "Wetterwarte der Magdeburgischen Zeitung," issued daily weather maps, and fostered the organization of a meteorological society which established a network of meteorological stations thruout central Germany. The first director of the Magdeburg Observatory, Richard Assmann, now director of the Aeronautical Observatory at Lindenberg, contributes a notice of Faber to the February number of Das Wetter.

The founder and former director of the Meteorological Observatory of Zágráb (Agram), Hungary, Prof. Ivan Stozir, died on February 12.

Notices of the deaths of Albert Lancaster and Sir Richard Strachey appear above. As these notes go to press news is received of the death of the distinguished Anglo-Indian meteorologist, Sir John Eliot; an account of his life will appear in a later number of the Review.

MR. THOMAS S. COLLINS.

Mr. Thomas S. Collins, Observer, Weather Bureau, died suddenly at Fort Smith, Ark., February 23, 1908. Mr. Collins was a member of the Service from 1872 until his death, with the exception of about a year in 1878–79, serving at some twenty stations, and was a faithful and efficient employee. He was a soldier in an Illinois regiment for three years during the Civil War.

[2] Polis, P. Der Wetterdienst und die Meteorologie in den Vereinigten Staaten von Amerika und in Canada. Studienreise unternommen im Auftrage des Kgl. Preuss. Ministers für Landwirtschaft, Domänen und Forsten. Berlin: Verlagsbuchhandlung Paul Parey. 1908.

STUDIES ON THE PHENOMENA OF THE EVAPORATION OF WATER OVER LAKES AND RESERVOIRS.

By Prof. Frank H. Bigelow.

[Read before the Philosophical Society of Washington, D. C., March 14, 1908.]

II.—THE OBSERVATIONS ON EVAPORATION MADE AT THE RESERVOIR IN RENO, NEVADA, AUGUST 1 TO SEPTEMBER 15, 1907.[1]

The expedition to Reno, Nev., announced in the Monthly Weather Review, July, 1907, to carry on some preliminary observations on the phenomena of evaporation, in preparation for the more extensive campaign at the Salton Sea, southern California, was successfully completed during the months of July, August, and September, 1907. I was accompanied by Mr. H. L. Heiskell from Washington, D. C., who assisted in the observations and the computations at Reno. We were associated with the following persons in the prosecution of the observations to whom the Weather Bureau is greatly indebted for their cooperation: Messrs. James W. Robeson, Edgar Pearson, J. F. Steffin, M. E. Jepson, Cedric Beebe, and Arthur Potthoff, as observers. Mr. H. O. Geren, local observer of the United States Weather Bureau, Prof. R. S. Minor and J. E. Church, jr., of the University of the State of Nevada, aided us in many ways, Mr. L. T. Borden, contractor, constructed the towers, and the pans were made by the Nevada Company, many other citizens of the city of Reno rendering us important services, which are cordially appreciated. The climate of Reno proved to be admirably adapted to our purposes, the air being very dry, the nights cool, and the sun hot at midday, so that the diurnal curves were very pronounced in all the meteorological elements. No showers occurred till near the end of the work, and the observations were continued day and night without interruption for six full weeks, during which time 35,000 observations, including nearly 100,000 readings of our instruments, were secured.

The Reno Reservoir is double, having a central dike running thru it on which a tower could be placed, one part supplying the city of Reno and the other part the city of Sparks with water at a considerable pressure. The water for these reservoirs is diverted from the Truckee River, which is the outlet of Lake Tahoe, 6,250 feet above sea level in the Sierra Nevada Mountains. These sierras are from 9,000 to 12,000 feet high and cut off the moist westerly winds of the Pacific Ocean, leaving the region east of the mountains very dry in the summer time, when only westerly winds prevail. At Mount Rose, on the crest of these mountains, 15 miles from Reno, about 10,500 feet high, Professor Church is maintaining an observatory, where continuous records are being secured the year round, which promises to add important data for high-level meteorology. The State University and the Agricultural Experiment Station are supplying the funds, which ought, if practicable, to be increased in order to expand the work to larger proportions.

The plain of Reno, being sheltered from the west and lying 4,000 feet above sea level, is subjected in summer to a remarkably uniform system of diurnal variations of the wind direction and velocity. In the forenoon it is calm until about 10 o'clock, when a breeze begins in the southeast and gradually swings to the westward, increasing in strength up to 30 or 40 kilometers per hour on many afternoons. We thus found the same meteorological conditions nearly repeating themselves day by day, thus including evaporation under calms and under high winds. There were enough calm afternoons occurring to enable us to separate our observations into three groups, with the winds between 1–10, 10–20, 20–40 kilometers per hour, and so to study the effect of the wind on the evaporation in an efficient manner. These local winds were caused by the drainage of cool air from the mountains down the Truckee River Valley, which extended due west from the Reno Reservoir.

[1] For paper No. I see Monthly Weather Review, July, 1907, Vol. XXXV, p. 311–316.

Fig. 1 shows the dimensions of the double reservoirs and the location of the five towers, the line thru them running from east to west. Tower No. 1 is located in a very dry uncultivated field, and the vegetation had no influence upon the rate of evaporation. Tower No. 5 is situated in the midst of an extensive field of alfalfa, which was regularly irrigated every two weeks and kept moist enough to throw up a decided cover of vapor to the depth of several feet. A similar blanket of vapor covers the water of the reservoir, and the primary problem is to determine the rate of the evaporation from pans which are located at different points in this vapor blanket.

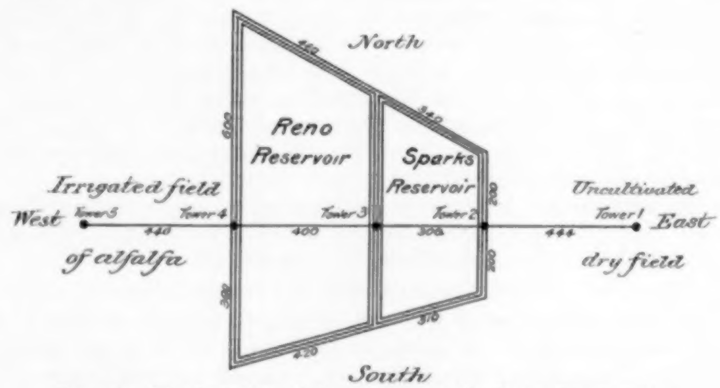

Fig. 1.—The location of five towers at the Reno Reservoir.

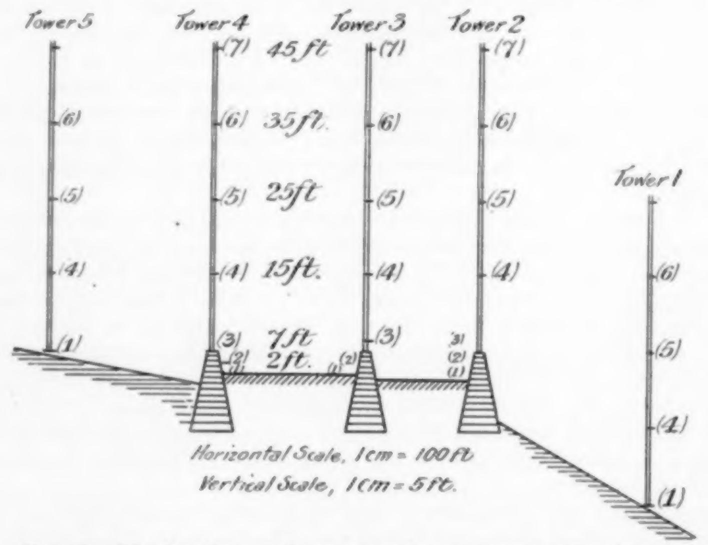

Fig. 2.—The location of the evaporation pans on the five towers.

Fig. 2 shows the location of the 29 pans which were operated during the campaign. There were 5 of the 6-foot pans, 10 inches deep, and 24 of the 2-foot pans employed; 3 of the 6-foot pans located in the water at the base of towers Nos. 2, 3, 4, and 2 of the 6-foot pans were placed on the ground at the foot of towers Nos. 1 and 5. The floating pans were surrounded by a framework of wood that stiffened them and acted as a buoy, and they were free to move within a barrier of floating breakwaters, two in succession, so that the inner spaces were freed from waves when the wind reached 20 kilometers per hour, after which there was more difficulty in keeping the spray out and the waves from surging under the breakwaters. It is not possible to float large pans in a lake which is subject to long waves and high winds, and at the Salton Sea no attempt will be made to float the pans. Instead

of this method, the pans will be suspended near the water and raised or lowered according to the weather conditions. The small 2-foot pans were, also, 10 inches deep, and they were placed on platforms extending over the south side of the towers, so that the sun was free to shine upon them from morning till night. There were three intentional exceptions made in the location of the pans. On tower No. 3 pan 3 was placed against the outside of the lower section, which was boarded in and served as an office room, so that it received an excess of heat during the day; pans 4 and 5, on the contrary, were placed on the north side of their platforms so that they were shaded by the upper platforms from 9 a. m. till 3 p. m., and contrasted with pan 3, by receiving a smaller amount of heat. The effect was to raise the vapor pressure in pan 3 and lower it in pans 4 and 5, relatively to the other pans on the same towers. There was, however, very little effect on the rate of the evaporation from these pans. The pans 7 on the top of towers Nos. 1 and 5 were not put in place, because their record would be almost identical with that of pans 6 on these towers. The pans on towers Nos. 2, 3, 4, and 5 were very nearly on the same levels.

Pan No. 7 at 45 feet.	Pan No. 3 at 7 feet.
Pan No. 6 at 35 feet.	Pan No. 2 at 2 feet.
Pan No. 5 at 25 feet.	Pan No. 1 at 0 feet.
Pan No. 4 at 15 feet.	

The tower No. 1 was located on ground which was about 20 feet lower than the bank of the reservoir. The nature of the soil was such that the record for the evaporation would have been the same if it had been raised to the common level of the other towers. The pans 1, 2, and 3 of tower No. 2 were reached by a bridge 20 feet long leading to the crib, and they were well surrounded by the waters of the reservoir on all sides. The pans 1 and 2, of towers Nos. 3 and 4 were reached by platforms extending into the lake from the shore, to which they were lashed, and they rose and fell as the waters of the reservoir changed their levels from day to day, the range being thru several feet during the summer.

Fig. 3 shows tower No. 2, with some pans on the ground. The lower section was boarded and sheathed against the weather, and it was occupied day and night by the observer, Mr. J. W. Robeson, to whose faithful and efficient services much of the success of this work is due. The lower section of tower No. 3 was used as an office, and that of tower No. 4 as a camp for other observers who were on duty during the night.

Fig. 4 gives a general view of the five towers looking eastward from No. 5 in the alfalfa field, and fig. 5 shows towers Nos. 2 and 3, and a portion of the western reservior which feeds the city of Reno, and especially the dike which enabled us to place a tower in the middle of the lake. The pans can be seen on the towers in the positions that have been desscrbed. Fig. 5 (*a*, *b*, *c*, *d*) give further details regarding the lower pans.

THE METHOD OF TAKING THE OBSERVATIONS.

The purpose for which the observations were planned was to discover, if possible, the immediate cause of the discrepancies which exist between the results of several excellent researches on the rate of evaporation in the open. These may be attributed to the adopted formulas, or to an actual difference in the rate of evaporation near the same body of water, as determined by the action of the vapor blanket which covers every lake. If large numbers of pans are placed at different points in this vapor cloud, and if they are precisely alike themselves, the method of observing being always uniform, then any difference in the observed rate at the different pans must be primarily a physical phenomenon to study, with the object of deriving a comprehensive general formula. The metric system of measurements were used thruout, because of its superior

advantages in the discussion of thermodynamic problems. An ordinary sling psychrometer, carrying wet and dry-bulb thermometers, was used to find the temperature and the dew-point of the air near the pans. A small raft was made, sustaining a water thermometer on the lower side, which was *just submerged beneath the surface of the water*, and on the upper side wet and dry-bulb thermometers floated about *one-half an inch above the water surface*. These instruments enabled us to obtain *the temperature and the vapor pressure, (1) at the surface of the water, (2) at a plane one-half an inch above the water surface, and (3) in the free air that was blowing over the pans.*

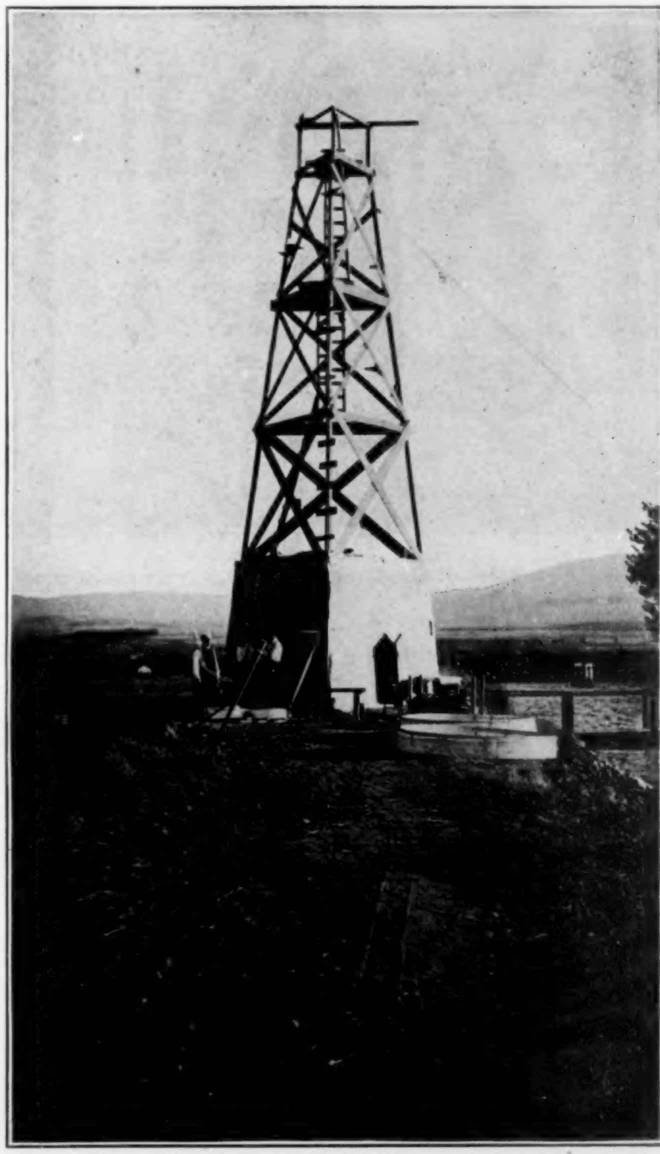

FIG. 3.—Tower No. 2, on the east bank of the reservoir, showing the landings for four pans, two of the 6-foot pans and several 2-foot pans on the ground near the tower. The towers are 40 feet high, built in a prism and guyed down with wire cables to withstand gusts of wind, as much as 40 miles per hour. The mountains on the right, looking south, include Mount Rose, about 16 miles distant.

To measure the depth of the water in the pans, the surface of which is always ruffled by the wind, we employed a glass tube graduated to cubic centimeters, the scale being nearly in millimeters, and the tube being drawn to a narrow neck at the bottom. A plunger consisting of a plug on a copper wire was fitted to move up and down with the finger as desired, which on being prest down shut off all communication thru the bottom. Raising this to the level of the eye the top of

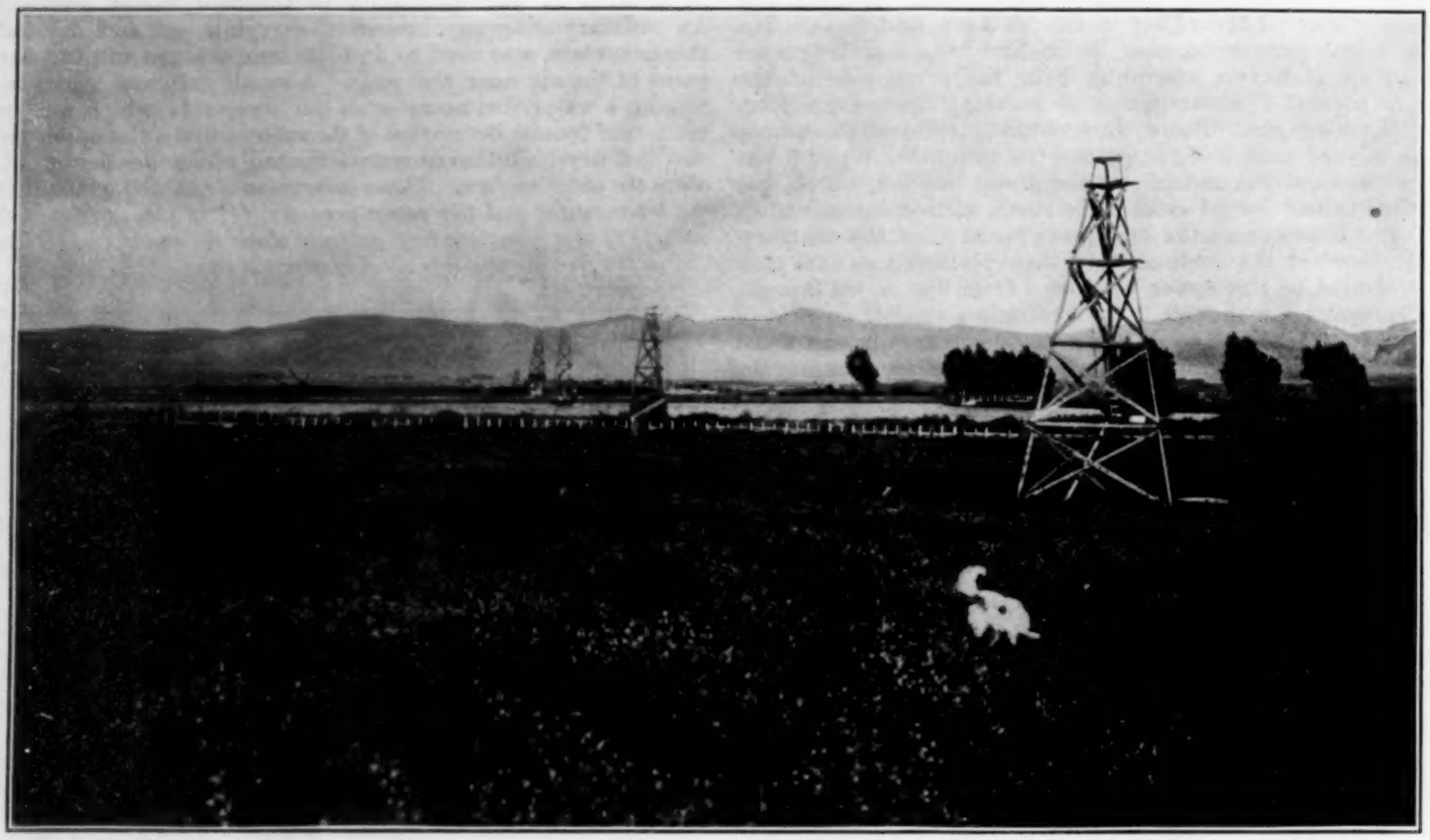

FIG. 4.—The location of the five towers for the evaporation pans. The distant tower is No. 1 to the east and the nearest is No. 5 to the west.

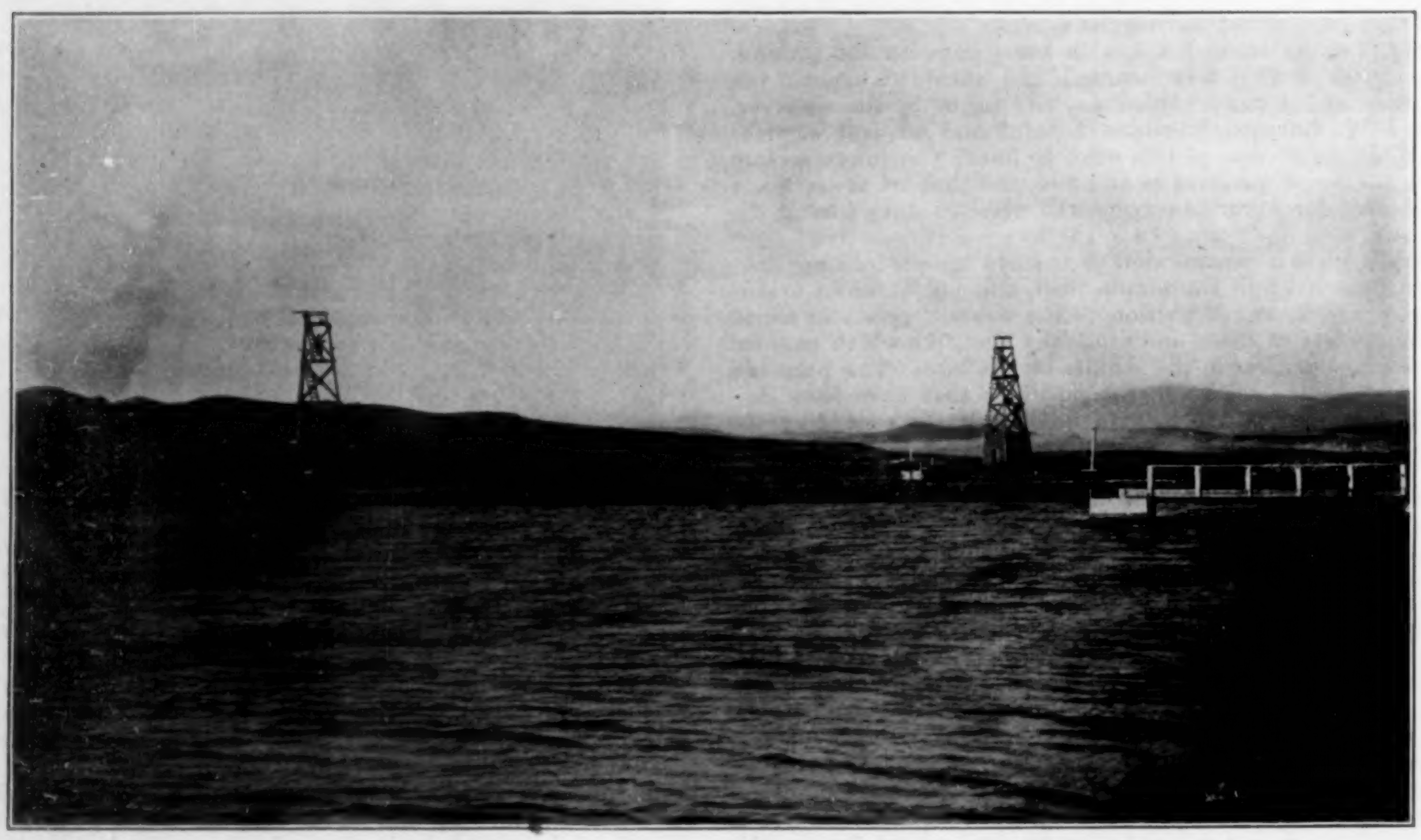

FIG. 5.—A portion of the Reno Reservoir, showing the central tower No. 3 and the tower No. 2. The crib at No. 2 was used to work three pans.

FIG. 5 *a*.—Pans at tower No. 2.

FIG. 5 *c*.—Pans at tower No. 1.

FIG. 5 *b*.—Pans at tower No. 2.

FIG. 5 *d*.—Pans at tower No. 4.

the meniscus of water was easily read off to a fraction of a millimeter on the vertical scale. No account was taken of the volume, but the scale was read from time to time at the same point in each pan, and the difference of height between readings measured the amount lost by the evaporation. The readings were finally reduced to millimeters by a proper scale-factor, and the difference of readings for a given interval, as three hours, is a measure of the amount evaporated in the pan. The sling psychrometer, the raft with the three attached thermometers, the vertical scale tube, and a dish of water for wetting the rag on the sling psychrometer, were placed in a basket and carried from pan to pan on the same tower, so that we are now dealing in our final results with strictly differential values, there being thus no question of corrections to the absolute readings of the instruments.

TABLE 5.—*Reno Reservoir. Diurnal variation of the vapor pressure. August 1-10, 12-17, 1907.*

Pan.	Tower.	1 a.m.			5 a.m.			8 a.m.			11 a.m.			2 p.m.			5 p.m.			8 p.m.		
		e_s	e_r	e_d	e_s	e_r	e_d	e_s	e_r	e_d	e_s	e_r	e_d	e_s	e_r	e_d	e_s	e_r	e_d	e_s	e_r	e_d
7	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	4	11.3	8.2	6.6	10.0	6.9	6.2	14.3	8.8	6.8	21.2	9.3	6.8	19.5	8.1	6.4	16.6	7.6	5.8	14.6	7.1	6.1
		11.8	8.3	6.3	11.0	9.4	6.5	16.6	11.8	7.3	24.5	11.4	7.1	24.4	8.7	6.4	18.2	7.1	6.1	14.0	8.3	5.7
	3	12.4	9.0	7.2	10.5	8.5	6.5	15.6	10.1	6.8	20.7	9.0	6.7	19.6	9.3	6.0	16.8	8.5	6.3	12.6	7.2	5.8
		13.0	7.4	4.7	10.7	7.8	5.5	15.0	11.9	7.7	21.8	11.3	7.5	24.9	9.5	6.4	19.8	8.3	6.5	15.0	7.2	5.9
	2	12.3	8.0	6.3	10.0	8.1	6.3	15.1	9.9	6.9	18.8	10.1	6.5	18.9	8.7	6.3	16.0	8.4	6.1	13.2	8.2	6.9
		9.8	8.0	5.6	10.4	7.9	6.3	15.5	11.5	6.9	22.4	10.5	5.8	24.7	8.8	7.7	17.9	8.6	6.0	16.0	8.7	5.5
	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Means		11.8	8.2	6.1	10.4	8.1	6.2	15.4	10.7	7.1	21.6	10.8	6.7	22.0	8.9	6.5	17.6	8.1	6.1	14.2	7.8	6.0
6	5	....	....	....	....	....	....	13.2	7.1	3.5	19.5	9.7	6.3	17.2	8.1	5.0	15.0	7.4	5.0	....	....	....
		....	....	....	....	....	....	18.1	11.8	7.6	23.9	11.7	8.6	23.3	9.6	6.3	17.9	7.9	5.8	....	....	....
	4	11.5	7.9	6.0	10.2	7.1	6.4	14.5	9.0	6.9	22.9	9.9	6.9	20.5	8.8	6.3	17.3	7.9	6.0	15.2	7.2	6.1
		11.8	8.9	6.6	10.7	8.5	6.3	16.1	11.9	7.9	24.1	12.1	7.2	25.7	8.8	6.5	18.9	7.6	6.1	14.1	7.7	5.7
	3	12.3	9.3	7.0	10.2	7.5	6.5	15.0	10.9	7.2	20.3	9.3	6.6	19.5	8.8	6.3	16.6	8.0	6.1	12.9	7.5	5.8
		13.0	7.1	4.8	10.3	7.7	5.6	14.2	10.1	7.6	21.7	10.5	7.9	24.9	9.4	6.5	19.7	7.0	6.1	14.8	7.3	5.5
	2	12.3	8.2	6.5	9.8	8.0	6.2	14.5	9.7	6.9	18.9	9.9	6.5	19.3	8.3	6.4	16.2	8.1	6.3	12.4	7.9	6.0
		9.8	8.3	5.7	10.2	7.5	6.3	14.8	11.4	7.2	22.2	11.0	6.0	24.9	9.6	6.7	18.2	8.6	5.8	16.4	9.0	5.5
	1	....	....	....	....	....	....	12.8	10.0	7.5	20.1	10.7	6.2	24.4	9.3	6.5	20.8	8.5	6.0	....	....	....
		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Means		11.7	8.3	6.1	10.2	7.7	6.2	14.9	10.2	6.9	21.5	10.5	6.8	22.2	9.0	6.3	17.8	7.9	5.9	14.3	7.8	5.8
5	5	....	....	....	....	....	....	13.3	7.5	5.7	19.5	9.5	6.3	18.0	7.5	5.1	16.0	7.8	5.4	....	....	....
		....	....	....	....	....	....	17.6	11.4	7.9	23.6	12.1	8.0	24.3	8.7	7.0	18.0	7.4	6.8	....	....	....
	4	11.2	7.7	6.6	9.6	6.9	6.4	13.8	9.6	6.9	22.6	10.2	7.3	20.8	9.2	6.4	17.8	8.5	6.0	15.3	7.8	6.2
		11.8	8.0	6.8	10.6	8.2	7.0	15.3	10.8	7.7	23.6	12.2	7.3	26.0	10.5	6.6	18.9	7.9	6.2	14.2	7.5	5.9
	3	12.2	7.8	7.2	10.3	8.3	6.4	13.3	9.7	7.1	15.2	7.6	6.6	18.1	9.4	6.3	17.0	9.0	6.0	13.3	7.6	5.9
		12.7	5.5	5.2	10.5	8.1	5.9	13.2	9.8	6.1	16.7	8.2	6.9	21.8	8.9	7.5	19.7	9.0	6.2	15.1	7.6	5.9
	2	12.3	7.2	7.2	9.8	7.9	6.2	14.3	10.0	7.2	18.4	10.1	6.4	19.6	8.7	6.5	16.5	8.0	6.2	13.3	7.5	5.7
		9.8	7.8	5.9	10.2	7.8	5.4	14.6	12.0	7.1	22.0	10.5	6.1	25.5	9.1	6.7	18.8	8.9	6.3	16.8	8.2	5.7
	1	....	....	....	....	....	....	12.9	9.7	7.3	19.6	10.0	6.2	24.9	9.5	6.3	21.6	9.2	5.7	....	....	....
		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Means		11.7	7.3	6.5	10.2	7.8	6.2	14.3	10.1	7.0	20.1	10.0	6.8	22.1	9.1	6.5	18.3	9.4	6.1	14.7	7.7	5.9
4	5	....	....	....	....	....	....	13.1	7.6	6.1	19.5	10.0	7.0	18.8	7.9	5.4	16.6	8.1	6.5	....	....	....
		....	....	....	....	....	....	17.3	12.0	8.4	23.6	12.6	9.0	25.3	9.9	7.1	18.8	7.4	6.1	....	....	....
	4	11.2	8.0	7.2	9.4	7.2	6.4	13.8	9.0	7.2	23.2	10.1	7.6	22.3	9.0	6.8	19.2	9.0	6.5	16.2	7.3	5.8
		11.5	7.2	6.9	10.5	7.9	6.6	14.8	11.8	8.2	23.7	12.6	7.5	27.3	9.9	7.1	19.5	8.2	6.4	14.7	7.2	5.9
	3	12.7	8.2	7.4	10.4	8.6	6.5	14.1	9.8	8.0	16.1	7.6	6.7	18.8	9.5	6.2	18.1	8.9	6.4	14.1	7.9	6.3
		13.3	7.5	6.8	10.5	8.0	6.2	12.6	9.9	7.3	16.0	8.5	7.3	23.1	8.9	8.0	20.7	8.7	7.0	16.0	7.5	6.3
	2	12.3	8.0	7.0	9.8	7.8	6.5	13.7	10.4	7.2	18.2	9.2	6.7	20.7	9.2	6.7	17.6	9.1	6.5	13.9	8.0	6.0
		10.5	8.4	5.8	10.1	7.9	6.3	14.2	12.0	7.1	21.7	10.9	6.3	26.6	9.3	7.0	19.4	9.4	6.8	17.7	8.7	6.1
	1	....	....	....	....	....	....	12.3	9.3	7.4	19.5	10.7	6.0	26.2	10.6	6.3	22.8	9.8	6.7	....	....	....
		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Means		11.9	7.9	6.7	10.1	7.9	6.4	14.0	9.1	7.6	20.2	10.2	7.1	23.2	9.4	6.7	19.2	8.7	6.5	15.4	7.8	6.1
3	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	4	11.7	7.7	7.5	9.9	7.3	6.7	12.8	9.0	7.9	19.4	9.0	9.1	19.8	8.6	7.6	20.1	9.9	6.9	16.7	7.6	5.9
		12.2	7.6	6.9	10.7	7.6	6.7	11.4	10.0	9.1	21.9	9.8	9.1	21.3	10.4	8.5	20.5	7.8	7.5	15.4	7.1	5.9
	3	13.0	8.2	8.2	10.5	8.8	6.9	15.2	11.0	7.6	19.7	10.5	7.5	23.3	11.5	7.1	19.6	9.6	6.9	14.6	8.8	7.2
		15.2	9.3	6.8	11.1	8.0	6.5	14.0	10.9	7.4	22.7	12.6	8.2	29.8	11.9	9.3	23.8	9.6	8.1	17.6	8.5	6.7
	2	12.3	9.4	7.7	10.0	7.9	6.4	13.9	9.6	7.3	17.8	9.5	6.9	21.2	9.4	6.5	18.1	8.8	6.8	14.2	8.6	6.4
		10.4	8.8	6.1	10.1	7.8	5.9	12.7	10.8	7.1	20.2	9.8	6.2	25.5	9.9	7.9	20.2	10.0	6.9	16.8	9.1	6.4
	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Means		12.5	8.5	7.2	10.4	7.9	6.5	13.3	10.2	7.7	20.3	10.2	7.8	23.5	10.3	7.8	20.4	9.3	7.2	15.9	8.3	6.4
2	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	4	11.9	8.7	8.2	11.1	7.5	7.1	14.0	9.5	7.6	22.5	11.0	8.6	23.8	9.9	7.2	21.8	11.0	7.3	17.6	8.7	6.0
		12.6	8.3	7.8	11.2	8.7	7.4	14.9	12.9	8.2	22.8	13.6	7.6	25.6	11.4	7.9	23.6	10.0	7.8	16.6	8.1	6.5
	3	13.4	8.9	8.1	10.6	7.9	7.0	12.6	9.1	7.6	18.4	11.3	7.9	23.3	13.0	7.2	22.1	10.3	7.5	17.2	8.6	6.6
		14.5	7.7	7.7	10.8	7.9	6.7	10.8	8.9	7.8	19.8	10.7	8.4	26.4	12.4	9.0	24.8	10.6	8.3	18.0	8.5	7.3
	2	13.1	9.5	7.4	10.1	8.2	6.8	12.7	10.2	7.5	17.1	10.7	7.2	21.5	10.0	7.5	18.3	9.4	7.1	14.5	9.2	6.5
		10.6	8.7	6.8	10.3	8.3	6.1	12.8	11.3	7.7	19.0	10.3	6.7	25.5	9.4	7.8	19.9	9.8	7.3	16.7	8.4	6.6
	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Means		12.7	8.6	7.6	10.7	8.1	6.9	13.0	10.3	7.7	19.9	11.3	7.7	24.3	12.7	7.8	21.8	10.2	7.6	16.8	8.6	6.6
1	5	....	....	....	....	....	....	12.6	8.1	7.0	20.4	10.7	8.3	21.3	9.7	6.3	18.6	9.3	6.5	...	....	....
		....	....	....	....	....	....	16.2	12.5	9.7	22.2	15.7	9.8	26.5	11.5	8.6	20.8	8.7	6.9	...	....	....
	4	15.6	9.4	8.5	14.1	8.3	7.1	16.1	11.1	9.4	20.3	12.1	9.8	18.9	10.5	8.1	16.9	10.3	7.5	15.2	10.1	6.3
		13.9	10.4	8.1	15.3	9.5	7.6	16.4	12.1	8.6	20.9	12.9	8.5	20.0	12.5	8.4	18.1	10.3	8.1	14.4	8.3	6.9
	3	15.3	11.0	8.6	15.0	8.7	7.4	15.9	10.4	8.1	19.1	11.4	8.6	19.0	14.6	7.9	17.9	13.4	8.4	15.4	9.3	7.1
		15.4	11.0	11.0	14.2	9.6	7.5	14.5	9.7	8.0	18.2	12.2	8.4	21.7	14.3	9.4	18.4	11.8	8.7	15.0	10.2	7.8
	2	14.4	9.5	8.8	13.9	9.9	6.8	15.8	11.2	7.6	18.4	11.4	7.9	18.3	10.8	7.4	16.3	10.1	7.8	13.7	10.5	6.6
		11.6	9.0	7.8	13.3	9.3	7.3	15.9	12.0	8.1	19.8	12.1	7.5	19.9	11.1	8.0	17.2	12.2	7.6	15.0	9.7	6.9
	1	....	....	....	....	....	....	11.9	8.0	7.5	17.6	11.1	7.6	26.4	11.1	6.9	24.2	10.0	7.4	....	....	....
		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Means		14.4	10.1	8.8	14.3	9.2	7.3	15.0	10.6	8.2	19.7	12.2	8.5	21.3	11.8	7.9	18.7	10.7	7.7	14.8	9.7	6.9

The unit = 1 millimeter of mercury.

The centigrade thermometers were kindly loaned to the expedition by Prof. R. S. Minor, Physicist of the University of Nevada, and the tubes were purchased in Reno. The anemometers were furnished by the Instrument Division of the Weather Bureau, having been adapted by Prof. C. F. Marvin to read in kilometers per hour. One anemometer was read continuously thruout the interval August 1 to September 14, and a special series of readings were taken with 13 anemometers by Mr. Robeson from September 21 to October 6, inclusive, at 8 and 11 a. m., and 2 and 5 p. m. These anemometers were distributed at the bottom and top of the towers Nos. 1, 4, and 5, while No. 3 had three instruments and No. 2 had four instruments. The differential action from the bottom to the top of the towers was thus reduced to a simple formula, which will be discust in the following paper of this series. The hours of observation were as nearly as possible 1, 5, 8, and 11 a. m., 2, 5, and 8 p. m. for all the towers, except that at 1 a. m. the towers Nos. 1 and 5 were omitted and on tower No. 2 the readings were made Monday and Thursday nights, on tower No. 3 Tuesday and Friday nights, and on tower No. No. 4 Wednesday and Saturday nights. The pans were filled about 10 o'clock every forenoon. The order of the readings at each tower was kept identical, so that the time elapsed was not very different from day to day, a record being made of the hour and minute of beginning and ending at each tower. It took from 40 to 70 minutes to read all the instruments at the seven pans on each of the middle towers, Nos. 2, 3, and 4, according to circumstances, and in nearly all cases the thermometers were read three times at each pan, as well as the tube for height, in order to insure accurate mean values. The labor of climbing the towers seven times daily and making the observations in the wind, which at times was more than 40 kilometers per hour, was not inconsiderable, and the observers are entitled to much praise for their patience and fidelity in executing this routine. No personal accidents occurred to the observers, tho several thermometers were broken during the summer. The result is that we now possess a large number of strictly differential values of the evaporation in the midst of meteorological conditions which characterize the lower layers of air and vapor, as they are superposed upon a body of water evaporating in a very dry climate where the wind factor is also very conspicuous.

THE TABLES OF VAPOR PRESSURE AND EVAPORATION AT THE RENO RESERVOIR AUGUST 1-10, 12-17, 1907.

The weekly summaries of the values of the vapor pressure and the evaporation are found in Tables 5 and 6. They are arranged to show these data for each pan on each tower for each week separately and for the seven hours of observation. From the dry-bulb temperature t and the wet-bulb temperature t_1 the vapor pressure was found by a special table, computed for the elevation of Reno, where the average barometric pressure is B=645 mm., using the formula,

$$e=e_0-0.00066\,B\,(t-t_1)\left(1+\frac{t_1}{873}\right). \qquad (27)$$

This formula differs somewhat from the one commonly found in psychrometric tables, where the full formula is slighly modified for the sake of convenience in computing. With the arguments t_1 (wet) and $t-t_1$ (dry-wet) the vapor pressure e is taken out. This table serves for the sling psychrometer and the floating psychrometer on the small raft. The vapor pressure of saturation at the temperature of the water gives a third value of the vapor pressure. As arranged on Table 5, there is found under each hour the mean weekly value of these three vapor pressures:

e_s= the vapor pressure at the temperature of the water;

e_r= the vapor pressure of the air one-half an inch above the water;

e_d= the vapor pressure of the air at the dewpoint temperature.

TABLE 6.—*Reno Reservoir. Diurnal variation of the evaporation. August 1-10, 12-17, 1907.*

Pan.	Tower.	8 p.m. to 1 a.m.	1 a.m. to 5 a.m.	5 a.m. to 8 a.m.	8 a.m. to 11 a.m.	11 a.m. to 2 p.m.	2 p.m. to 5 p.m.	5 p.m. to 8 p.m.	Total.
7	5	......	......	......	......	......	......	......	......
		......	......	......	......	......	......	......	......
	4	.207	.248	.190	.273	.395	.375	.295	1.983
		.159	.147	.204	.249	.388	.475	.393	2.015
	3	.239	.225	.161	.170	.413	.388	.328	1.944
		.173	.130	.176	.207	.388	.332	.303	1.709
	2	.197	.189	.189	.293	.513	.440	.251	2.072
		.132	.130	.203	.331	.516	.437	.234	1.983
	1	......	......	......	......	......	......	......	......
Means		.188	.178	.187	.253	.435	.407	.300	1.951
6	5	.176	.193	.194	.294	.397	.293	.155	1.702
		.139	.128	.184	.207	.356	.278	.217	1.509
	4	.215	.228	.181	.217	.449	.264	.284	1.838
		.145	.137	.184	.261	.346	.337	.337	1.747
	3	.265	.251	.170	.202	.367	.345	.228	1.828
		.173	.158	.130	.176	.488	.400	.383	1.908
	2	.200	.167	.189	.259	.533	.471	.228	2.047
		.121	.107	.234	.331	.502	.406	.282	1.983
	1	.099	.082	.141	.312	.464	.446	.234	1.778
Means		.169	.161	.178	.251	.483	.360	.261	1.811
5	5	.155	.194	.172	.258	.379	.259	.155	1.572
		.145	.155	.207	.161	.346	.371	.195	1.580
	4	.190	.176	.139	.207	.288	.253	.230	1.483
		.118	.112	.149	.116	.346	.311	.379	1.531
	3	.251	.236	.150	.256	.323	.340	.228	1.784
		.161	.144	.130	.193	.325	.449	.325	1.727
	2	.175	.171	.197	.240	.460	.491	.262	1.996
		.121	.119	.267	.361	.502	.392	.172	1.934
	1	.085	.088	.127	.366	.446	.375	.212	1.699
Means		.155	.155	.159	.240	.379	.360	.239	1.701
4	5	.145	.182	.190	.226	.362	.207	.139	1.451
		.139	.155	.149	.184	.311	.333	.207	1.478
	4	.166	.166	.126	.221	.242	.275	.230	1.396
		.124	.112	.104	.058	.242	.265	.379	1.284
	3	.202	.172	.127	.170	.382	.395	.167	1.615
		.127	.058	.112	.130	.293	.351	.403	1.474
	2	.164	.155	.252	.259	.298	.406	.197	1.731
		.113	.129	.220	.330	.423	.375	.220	1.810
	1	.079	.096	.093	.141	.541	.375	.175	1.560
Means		.139	.136	.152	.191	.343	.331	.225	1.526
3	5	......	......	......	......	......	......	......	......
		......	......	......	......	......	......	......	......
	4	.162	.221	.161	.177	.265	.242	.207	1.435
		.189	.134	.116	.158	.219	.265	.311	1.392
	3	.173	.135	.118	.213	.360	.288	.258	1.545
		.070	.101	.161	.225	.271	.320	.266	1.414
	2	.133	.149	.220	.197	.282	.293	.209	1.483
		.104	.119	.189	.299	.384	.344	.141	1.580
	1	......	......	......	......	......	......	......	......
Means		.138	.143	.160	.211	.296	.292	.236	1.475
2	5	......	......	......	......	......	......	......	......
		......	......	......	......	......	......	......	......
	4	.124	.104	.116	.207	.288	.127	.239	1.205
		.083	.060	.079	.158	.216	.175	.245	1.016
	3	.181	.204	.115	.150	.270	.165	.172	1.257
		.058	.086	.112	.193	.144	.239	.188	1.020
	2	.149	.133	.120	.124	.298	.224	.182	1.230
		.113	.141	.103	.234	.230	.251	.169	1.241
	1	......	......	......	......	......	......	......	......
Means		.118	.121	.108	.178	.241	.197	.198	1.162
1	5	.114	.104	.139	.207	.311	.172	.139	1.286
		.124	.104	.161	.139	.149	.288	.139	1.104
	4	.091	.031	.126	.188	.159	.139	.139	0.873
		.071	.068	.126	.080	.126	.184	.116	0.771
	3	.040	.055	.058	.127	.144	.193	.060	0.677
		.092	.072	.176	.172	.176	.127	.130	0.945
	2	.136	.116	.175	.200	.324	.382	.234	1.467
		.093	.119	.214	.220	.299	.234	.172	1.351
	1	.093	.062	.152	.200	.475	.371	.223	1.476
Means		.095	.081	.137	.170	.240	.221	.160	1.115

The unit = 1.000 centimeters in height.

On tower No. 1 the readings for the first week were not secured because it was not finished. The pans on towers Nos. 5 and 1 were not read during the night, but they would show very little difference from those on the other towers during the nighttime, when the air was cool. We possess similar tables of the vapor pressure and the evaporation for the other four weeks, as well as the corresponding tempera-

ture tables, but those which are here presented illustrate sufficiently their general appearance, and from them the main features of the phenomenon can be readily learned. The original tables which give the results day by day show how steady the climate of Reno is during the summer months, and how favorable the conditions were for bringing to light the subtle physical conditions under which the evaporation takes place, and to which it responds with remarkable sensitiveness. We are concerned in this paper simply with the action of the evaporation at the several towers and at different heights above the water. In the following paper of this series we shall discuss the diurnal variation and the formula which seems to be competent to eliminate the diurnal changes of rate of the evaporation.

Table 5 is transferred to figs. 6–12, where the characteristics of the vapor pressure are shown every three hours on six pans at the five towers. On figs. 9 and 10, at tower No. 3, pan 3, will be noted the excess of e_s, due to an overheating of the water in the pans, and at pans 4 and 5 a defect due to shading the pans, as stated above. The vapor pressure at the surface of the water e_s ranges thru wide limits, 12 to 24 mm., while the vapor pressure of the air very near the water e_r and in the air somewhat free from the water ranges very little during the day, e_r changing between 7 and 12 mm., while the vapor pressure of the air e_d ranges from 6 to 9 mm. The courses of e_r and e_d are nearly parallel thruout the day at all the towers, the spaces widening somewhat in the heat of the day as compared with the night. Table 6 is transferred to figs. 13–20, where the characteristics of the evaporation are shown from hour to hour at the seven pans on each tower. It was necessary to interpolate values on towers Nos. 1 and 5 at the pans 2, 3, and 7, but it is evident that this can properly be done under the circumstances. The increase of the evaparation from 5 a. m. to 2 p. m. is strikingly illustrated, and also the facts that the evaporation is less in the middle of the lake than at the side towers, also less than in the upper pans. The lower pan of tower No. 5 in the moist alfalfa field is less than at tower No. 1 in the dry field, so that the irrigated field partakes of the nature of an imperfect water surface. A study of these tables and diagrams and the evident necessary inferences are very interesting. *They show clearly that the location of the pans relative to the water of a reservoir is of primary importance in measuring the total amount of evaporation, and that observations on a pan away from the water can not be transferred to the water surface itself except with the utmost caution.*

III.—DISCUSSION OF THE OBSERVATIONS MADE AT RENO, NEV., AUGUST 1 TO SEPTEMBER 15, 1907.

THE METEOROLOGICAL DATA.

The observations on the five towers erected at the Reno Reservoir afford an unusual opportunity to study the variations of the temperatures of the water, the air above the water, the vapor pressures, the wind velocities, and the evaporation, as functions of the height up to about 50 feet. These are valuable for meteorologists generally because they have an application to the questions of the exposures of the instruments at different levels. No attempts were made to use shelters of any sort, the psychrometers being swung vigorously in the free air, the motion being sufficient to eliminate the direct solar radiation, as was found by some comparative experiments. The thermometers on the raft were so close to the water surface as to be controlled by it, one being submerged, another being attached by a moistened rag hanging in the water, and the dry thermometer lying in the vapor of the evaporating water, from which there is no reflected heat. In discussing the subject of evaporation it is of first importance to separate out the effect of the wind velocity, and next it is necessary to find a function that will eliminate the diurnal variation, there being left a third function which depends upon diffusion in a quiet atmosphere at a given temperature. In order to measure the wind velocity the ordinary Robinson anemometers of the Weather Bureau pattern, reading on the dials in miles per hour, were transformed by a device of Prof. C. F. Marvin to read in kilometers per hour on the same dials. During the time which elapsed before these instruments were delivered a standard anemometer in miles per hour was read near the bottom of tower No. 2, at pan 3, thruout the observations. Afterwards the twelve new anemometers in kilometers per hour were added and distributed up and down the towers, two on No. 1, three on No. 2, three on No. 3, two on No. 4, two on No. 5, besides the English anemometer. During the interval of these special wind observations the number of those at the high velocities was not very great, but the evidence from the three anemometers on each of towers Nos. 2 and 3 is that a straight line, inclined at different angles, may be used to connect the velocity at the bottom with the velocity at the top of the tower. The result of the discussion is shown on figs. 21 and 22. A given wind velocity at the bottom is accompanied on the average by a different wind velocity at the top as indicated on fig. 21. If the differences between the wind at the top and the wind at the bottom, Δv, be taken and plotted as ordinates to the wind velocity at the bottom, the points appear on fig. 22 near the line marked pan 7 at the top of the tower. It is nearly a straight line, making an angle $\alpha = 22° 20'$ with the base. The precepts leading to the general formula,

$$v_1 = v + 0.410 \frac{h}{h_0} v, \qquad (28)$$

are given in fig. 22, where v is the velocity at the bottom, h the height of the pan and h_0 the height of the tower, v_1 the required velocity at a given pan. Practically the mean velocities of the English anemometer were obtained separately for the six weeks of the observations. The special metric anemometer readings were sorted into groups for each tower for winds between the limits: 0–5, 5–10, 10–15, ... 45–50 kilometers per hour at the bottom, middle, and top of the towers, and plotted on diagrams. Mean sloping lines were drawn individually and then intermediate lines from the velocities at the bottom, 0, 5, 10, ... 40, 45. The readings at the top were scaled from the diagrams and they are given in Table 7, increase in the wind velocity from bottom to top of the tower, the bottom meaning the water surface for towers Nos. 2, 3, and 4, and the ground for Nos. 1 and 5.

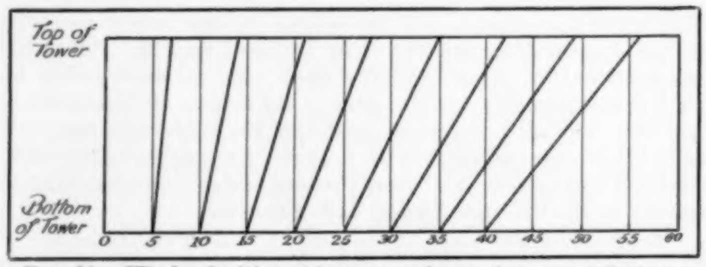

FIG. 21.—Wind velocities at bottom and top of towers, kil./hour.

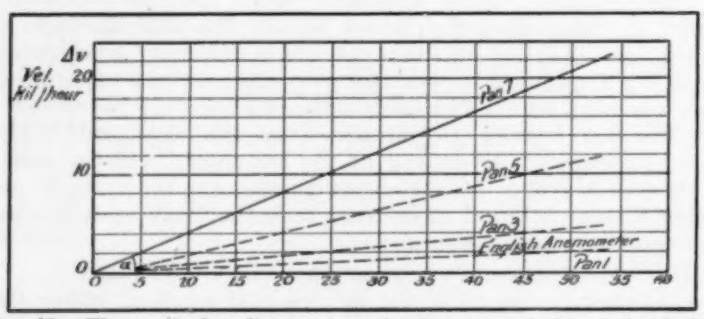

FIG. 22.—The vertical ordinate gives the increase of the wind velocity at the higher point over that at the lower point.

v = velocity at the bottom of the tower.
v_1 = velocity at the higher point.
$v_1 = v + v \tan a = v\ (1 + \tan a)$.

For the top of the tower, pan 7, $a = 22°\ 20'$

$v_1 = v + v \tan 22°\ 20' = v\ (1 + 0.41) = 1.41\ v$.

The velocity of the English anemometer is transferred to other heights, pan 1, pan 3, pan 5, pan 7, by adding the proper ordinates from this diagram.

General formula.

$$v_1 = v + 0.41 \frac{h}{h_0} v, \text{ where}$$

h_0 = height of the tower and
h = height of the pan.

TABLE 7.—*Increase in the wind velocity from the base to the top of the towers.*
v = velocity in kilometers per hour.

Tower.	Base.	Top.	Base.	Top.	Base.	Top.	Base.	Top.	Base.	Top.
No. 1	5.0	6.7	10.0	13.6	15.0	21.4	20.0	28.7	25.0	35.6
No. 2		8.3		15.0		21.2		28.4		36.1
No. 3		6.6		11.6		18.1		26.2		32.7
No. 4		7.4		13.8		21.2		29.8		37.8
No. 5		7.0		13.8		20.9		28.0		35.2
v	5.0	7.20	10.0	13.56	15.0	20.56	20.0	28.12	25.0	35.48
Δv	2.20		3.56		5.56		8.12		10.48	

Tower.	Base.	Top.	Base.	Top.	Base.	Top.	Base.	Top.
No. 1	30.0	41.6	35.0	46.5	40.0	52.7	45.0	58.8
No. 2		44.6		52.4		60.8		....
No. 3		39.0		46.7		54.5		62.3
No. 4		45.3		52.5		60.9		....
No. 5		41.8		48.5		56.3		....
v	30.0	42.46	35.0	49.32	40.0	57.04	45.0	60.55
Δv	12.46		14.32		17.04		15.55	

The differences in the wind velocity Δv are plotted near the line pan 7 in fig. 22.

The entire system of meteorological data has been sorted out into three groups, namely, those in which the wind velocity at the pan 1 lies between the limits 1–10, 10–20, 20–40 kilometers per hour. The wind values for these groups at each of the pans 1, 3, 5, and 7 have been computed, that is, the average wind for the actual hours of the observations from August 1 to September 15, with the result that the following wind velocities have been used in the reduction of the observations, after smooth lines have been drawn thru the diurnal variations. The mean values for the three-hour intervals have been employed, for the sake of the integration of the evaporation.

TABLE 8.—*Mean wind velocities at the pans 1, 3, 5, and 7 for the three-hour intervals ending with the given hour.*

Wind.	2 *a*	5 *a*	8 *a*	11 *a*	2 *p*	5 *p*	8 *p*	11 *p*
PAN 7.								
1-10 w_1	3	2	3	5	7	8	6	3
10-20 w_2	18	17	19	21	22	22	21	19
20-40 w_3	32	31	31	34	37	38	37	34
PAN 5.								
1-10 w_1	2	2	3	4	6	7	5	3
10-20 w_2	16	15	17	19	20	20	19	17
20-40 w_3	28	27	27	30	33	33	32	30
PAN 3.								
1-10 w_1	2	2	2	4	5	6	4	3
10-20 w_2	14	13	15	17	18	17	16	15
20-40 w_3	24	23	23	26	28	29	27	25
PAN 1.								
1-10 w_1	2	1	2	4	6	6	4	2
10-20 w_2	18	13	14	16	17	17	15	14
20-40 w_3	22	21	22	25	27	28	26	24

In spite of the fact that the number of observations is large, yet when they are distributed into these three groups of wind velocities, and they are to be carried thru the eight groups of three-hour intervals for the twenty-four hours of the day, in order to discuss the diurnal period, there is a failure of observations during the night and morning hours, while the data are quite reliable during the afternoon hours. It has been necessary to control the actual observations by the construction of diurnal curves of all the elements, in order to secure approximate mean values. Since the purpose of this research was to obtain a formula for further observations, and some general views regarding the subject of evaporation itself, it was thought proper to proceed in this manner. When one branch of a single-period diurnal curve is well defined, as from 11 a. m. to 8 p. m., it is easy to extend it to cover the twenty-four hours, provided the 5 a. m. or minimum point can be determined. We had sufficient observations for this purpose, and so have conducted the discussion of the observations in this way. It may be remarked in passing that the three-hour amounts of evaporation at pans 1, 3, 5, and 7 on the five towers were plotted in two ways in succession under the three wind groups, in order that the observations might mutually adjust themselves over the gaps where the number of them is not adequate. (1) The four evaporations for the several pans were *first grouped under the three wind velocities* 1–10, 10–20, 20–40, the curves being drawn by the observations which were rather irregular, except for the low wind velocity, 1–10, where the number of the observations is great. (2) Then these curves were re-collected so that the *three wind groups appear under each pan*, as on the diagrams of figs. 23–27. This method of double plotting of curves and mutual adjustment is very efficient in dealing with insufficient data.

It is quite impracticable to reproduce the original data in this paper, on account of its bulk, nor is it possible to describe the numerous tentative attempts to discover a formula which seems to be capable of accounting for the numerous variations. We shall proceed at once to the finished product so far as the data are concerned, and make only a few remarks regarding the preliminary formulas. Tables 9, 10, 11, 12, and 13, contain the dry-bulb temperature t, the temperature of the surface of the water S, the vapor pressure e of the air computed from the table with the arguments t_1 the wet-bulb temperature, and $t - t_1$, and the evaporation E for every three successive hours thruout the day. The data given in these tables were scaled from the diurnal curves which have been constructed as stated, and the curves may be readily reproduced for study. Under each element t, S, e, E are given separately the results for each of the wind groups, 1–10, 10–20, 20–40, the sorting being now carried, not to individual days when these winds prevailed, but to individual hours. Since the high winds occurred chiefly in the afternoon, it gave much more data for the hours noon to midnight than for the hours midnight to noon. This lack of balance made the discussion of the observations rather difficult, and will justify a longer campaign in the Salton Sink, extending over several years. On figs. 23, 24, 25, 26, and 27 are given the evaporation curves corresponding with the data on Tables 9–13, and they are also the direct results of the formula that has been adopted.

A comparison of these data with the original rough data shows that the computed results represent the observations as well as practicable, except possibly at the 8 p. m. ordinate, which seems rather large. The evaporation may be found to drop more rapidly than the formula permits without a minor correction. This difficulty may disappear as the result of a better determination of the evaporation curves. On plotting the temperature curves together, t, S, as in fig. 28 for tower No. 1, it is seen that the temperature of the pans on the

TABLE 9.—*Tower No. 1, in dry field east of reservoir. Meteorological data.*

PAN 1.

Symbol.	Wind.	A. M.				P. M.				Mean.	Hour of mean ordinate.	
		2	5	8	11	2	5	8	11		a. m.	p. m.
t	0-10	12.3	11.6	16.0	23.0	25.6	23.4	18.1	15.0	18.1	......	......
	10-20	14.8	14.4	20.0	25.7	27.5	23.4	16.8	16.0	19.8	......	......
	20-40	16.2	16.6	20.8	24.3	27.5	26.0	19.5	17.2	21.0	......	......
S	0-10	11.5	10.3	12.1	18.4	24.6	24.3	20.2	15.1	17.1	......	......
	10-20	15.7	15.7	17.0	21.0	24.9	22.0	17.8	16.4	18.8	......	......
	20-40	15.0	14.9	16.4	20.3	24.0	20.9	17.3	15.8	18.1	......	......
e	0-10	5.6	6.0	6.8	6.8	6.7	6.2	5.7	5.6	6.2	......	......
	10-20	6.5	6.9	7.0	7.0	6.8	6.5	6.1	6.1	6.6	......	......
	20-40	6.4	6.7	6.8	6.9	6.7	6.4	6.0	6.0	6.5	......	......
E	0-10	.135	.110	.127	.167	.245	.266	.220	.172	.180	11.5	10.5
	10-20	.164	.135	.157	.217	.328	.344	.278	.212	.229	11.5	10.3
	20-40	.190	.150	.178	.244	.370	.397	.320	.242	.261	11.5	10.4

PAN 3.

											a. m.	p. m.
t	6-10	12.6	11.3	16.2	22.8	25.0	22.8	18.0	15.0	18.0	......	......
	10-20	15.0	14.8	19.2	24.7	26.6	22.6	17.5	16.0	19.6	......	......
	20-40	17.0	16.6	20.0	24.0	26.4	25.7	20.2	18.0	21.0	......	......
S	0-10	11.6	10.2	12.5	19.0	24.3	24.2	20.2	15.0	17.1	......	......
	10-20	15.0	15.2	18.0	22.0	24.8	21.4	17.6	15.8	18.7	......	......
	20-40	14.5	14.7	17.0	20.6	23.2	20.3	16.8	15.0	17.8	......	......
e	0-10	5.7	6.1	6.8	6.5	6.4	6.0	5.7	5.7	6.1	......	......
	10-20	6.3	6.7	6.8	6.5	6.0	5.7	5.7	5.9	6.2	......	......
	20-40	5.9	6.2	6.4	6.2	5.7	5.5	5.5	5.7	5.9	......	......
E	0-10	.137	.118	.130	.172	.243	.270	.222	.177	.184	11.6	10.5
	10-20	.172	.144	.166	.230	.320	.347	.282	.220	.235	11.5	9.8
	20-40	.200	.170	.185	.260	.365	.402	.337	.258	.272	11.4	10.4

PAN 5.

											a. m.	p. m.
t	0-10	12.8	11.7	16.2	22.2	24.6	23.0	19.3	16.5	18.3	......	......
	10-20	15.0	14.7	19.2	24.7	26.0	22.8	18.8	17.0	19.8	......	......
	20-40	16.3	16.2	20.0	24.0	26.0	25.3	20.7	18.2	20.8	......	......
S	0-10	11.8	11.0	12.9	19.4	24.2	23.5	19.2	15.0	17.1	......	......
	10-20	15.4	15.6	18.0	21.7	24.2	22.0	17.3	16.1	18.8	......	......
	20-40	14.8	14.8	17.0	20.0	22.2	20.0	16.7	15.7	17.6	......	......
e	0-10	5.5	5.6	6.6	6.3	6.3	5.7	5.6	5.4	5.9	......	......
	10-20	6.3	6.6	6.8	6.5	5.9	5.6	5.6	5.7	6.1	......	......
	20-40	5.9	6.3	6.5	6.0	5.6	5.4	5.4	5.6	5.8	......	......
E	0-10	.152	.130	.146	.200	.270	.287	.230	.186	.200	11.0	10.1
	10-20	.195	.165	.192	.265	.362	.386	.310	.250	.266	11.0	9.8
	20-40	.230	.192	.218	.306	.430	.454	.360	.308	.312	11.0	9.9

PAN 7.

											a. m.	p. m.
t	0-10	13.7	12.1	16.7	22.3	24.6	22.6	18.6	16.0	18.3	......	......
	10-20	15.6	15.1	19.0	24.2	26.0	22.0	18.0	16.3	19.5	......	......
	20-40	16.4	16.2	20.0	24.0	25.4	25.0	20.6	18.2	20.7	......	......
S	0-10	11.8	10.5	13.0	19.7	24.2	23.7	19.0	15.2	17.1	......	......
	10-20	14.1	14.4	17.0	20.8	24.0	20.3	16.4	15.0	17.8	......	......
	20-40	13.7	13.8	16.0	20.0	22.3	19.8	16.2	14.3	17.0	......	......
e	0-10	5.5	5.9	6.7	6.3	6.2	5.4	5.2	5.3	5.8	......	......
	10-20	6.2	6.6	6.8	6.6	6.0	5.6	5.5	5.4	6.1	......	......
	20-40	5.8	6.3	6.6	6.2	5.8	5.4	5.3	5.2	5.8	......	......
E	0-10	.154	.134	.154	.210	.287	.295	.235	.186	.207	10.8	9.5
	10-20	.206	.173	.208	.294	.396	.410	.320	.250	.282	10.7	9.4
	20-40	.248	.210	.243	.340	.475	.490	.400	.307	.339	10.9	9.8

TABLE 10.—*Tower No. 2, on eastern bank of reservoir. Meteorological data.*

PAN 1.

											a. m.	p. m.
t	0-10	13.7	11.8	16.9	23.0	24.7	22.8	21.2	17.0	18.9	......	......
	10-20	15.9	15.0	20.8	24.6	25.7	23.3	19.3	17.0	20.2	......	......
	20-40	17.0	16.7	20.0	21.7	24.8	24.0	20.0	18.1	20.3	......	......
S	0-10	14.9	14.7	17.3	20.8	21.2	20.2	18.6	16.6	18.0	......	......
	10-2b	16.0	16.8	19.4	20.7	21.5	19.0	16.7	16.0	18.3	......	......
	20-40	15.0	15.2	17.0	18.4	19.7	18.0	16.0	15.0	16.8	......	......
e	0-10	6.2	6.4	7.3	7.3	7.2	6.9	6.7	6.4	6.8	......	......
	10-20	6.7	7.2	8.3	7.7	7.8	7.7	6.7	6.5	7.3	......	......
	20-40	6.4	6.5	7.0	7.3	7.0	7.0	6.4	6.2	6.7	......	......
E	0-10	.130	.118	.140	.181	.202	.191	.172	.148	.160	9.4	9.0
	20-20	.150	.140	.178	.222	.260	.250	.220	.187	.202	9.6	9.4
	20-40	.180	.158	.198	.260	.297	.288	.252	.212	.231	9.5	9.5

TABLE 10.—*Tower No. 2*—Continued.

PAN 3.

Symbol.	Wind.	A. M.				P. M.				Mean.	Hour of mean ordinate.	
		2	5	8	11	2	5	8	11		a. m.	p. m.
t	0-10	14.2	11.5	16.7	23.2	25.1	23.0	21.4	16.4	18.9	......	......
	10-20	14.6	15.0	19.8	24.2	26.2	24.0	19.2	18.0	20.1	......	......
	20-40	17.2	17.2	20.1	21.8	25.7	24.6	20.0	18.0	20.6	......	......
S	0-10	11.2	9.8	13.0	19.0	23.3	23.4	20.4	15.8	17.0	......	......
	10-20	12.3	11.8	16.0	20.2	23.8	21.0	16.2	14.2	16.9	......	......
	20-40	11.2	10.6	13.5	18.1	21.5	19.4	15.0	12.9	15.3	......	......
e	0-10	5.7	5.9	6.9	6.9	7.0	6.7	6.0	5.7	6.4	......	......
	10-20	6.4	7.2	8.0	6.5	6.7	6.7	5.8	5.7	6.6	......	......
	20-40	5.6	5.7	5.5	6.0	5.9	6.0	5.9	5.7	5.8	......	......
E	0-10	.130	.103	.117	.175	.241	.264	.220	.164	.177	11.1	10.4
	10-20	.164	.128	.150	.230	.320	.340	.287	.220	.230	11.0	10.5
	20-40	.190	.150	.182	.276	.362	.395	.315	.250	.265	10.6	10.3

PAN 5.

											a. m.	p. m.
t	0-10	14.1	11.5	16.4	23.3	24.3	22.3	22.6	17.8	19.0	......	......
	10-20	16.1	16.2	21.0	24.5	25.2	23.4	19.7	18.6	20.6	......	......
	20-40	18.0	18.0	20.7	21.4	25.1	24.1	20.2	18.7	20.8	......	......
S	0-10	11.6	9.7	14.1	20.5	24.2	23.0	19.7	15.6	17.3	......	......
	10-20	12.2	12.0	17.2	21.3	23.0	20.0	15.8	13.8	16.9	......	......
	20-40	11.3	11.0	15.0	18.8	20.8	18.2	14.2	12.2	15.2	......	......
e	0-10	5.2	5.3	6.6	6.1	6.3	6.0	5.2	5.0	5.7	......	......
	10-20	5.7	7.0	8.0	6.1	6.2	6.0	5.4	5.2	6.2	......	......
	20-40	5.3	5.7	5.8	5.8	5.7	5.5	5.2	5.1	5.5	......	......
E	0-10	.143	.118	.143	.213	.270	.292	.240	.186	.201	10.6	10.1
	10-20	.192	.150	.188	.282	.360	.395	.322	.241	.266	10.4	9.8
	20-40	.222	.172	.212	.327	.423	.460	.370	.298	.310	10.6	10.4

PAN 7.

											a. m.	p. m.
t	0-10	14.3	12.0	17.7	23.0	24.7	22.0	22.6	19.0	19.4	......	......
	10-20	16.0	16.3	22.1	24.8	25.8	23.5	20.0	17.8	20.8	......	......
	20-40	17.8	17.9	20.4	21.2	24.7	23.9	20.2	18.9	20.6	......	......
S	0-10	11.6	9.7	14.7	21.0	24.0	22.2	19.0	15.4	17.2	......	......
	10-20	12.2	12.1	17.1	21.6	23.0	19.2	15.7	13.4	16.8	......	......
	20-40	11.1	11.0	14.6	18.8	20.2	17.8	14.0	12.1	15.0	......	......
e	0-10	5.3	5.5	6.6	6.3	6.4	6.1	5.6	5.5	5.9	......	......
	10-20	5.8	6.8	7.9	6.0	6.9	6.1	5.5	5.5	6.3	......	......
	20-40	5.5	5.6	5.5	5.6	5.7	5.3	5.1	5.2	5.4	......	......
E	0-10	.153	.123	.152	.232	.292	.307	.250	.192	.213	10.5	9.8
	10-20	.200	.160	.200	.315	.407	.420	.340	.243	.286	10.4	9.5
	20-40	.242	.185	.240	.370	.480	.505	.407	.307	.342	10.4	9.9

TABLE 11.—*Tower No. 3, on dike in midst of reservoir. Meteorological data.*

PAN 1.

											a. m.	p. m.
t	0-10	13.0	11.6	15.8	22.0	24.1	22.0	21.7	16.7	18.4	......	......
	10-20	15.7	15.8	19.5	21.5	24.0	23.3	19.8	17.0	19.6	......	......
	20-40	16.0	14.7	18.0	19.4	24.0	24.3	20.0	17.8	19.3	......	......
S	0-10	16.1	15.3	16.7	19.7	21.3	20.0	18.3	17.2	18.1	......	......
	10-20	17.6	17.8	18.0	19.2	21.2	20.2	18.0	17.5	18.7	......	......
	20-40	16.9	17.0	17.6	18.4	20.2	19.3	17.0	16.7	17.9	......	......
e	0-10	6.6	6.7	7.0	7.5	7.3	7.0	7.0	7.0	7.0	......	......
	10-20	7.3	8.8	8.7	6.7	7.8	7.3	6.5	6.5	7.4	......	......
	20-40	5.4	5.3	6.6	6.3	7.1	7.6	6.3	5.7	6.3	......	......
E	0-10	.105	.100	.095	.120	.140	.140	.127	.112	.117	10.3	10.5
	10-20	.130	.118	.116	.153	.182	.177	.158	.138	.147	10.5	10.4
	20-40	.148	.132	.133	.177	.207	.203	.182	.157	.167	10.4	10.4

PAN 3.

											a. m.	p. m.
t	0-10	13.1	11.4	16.3	22.8	24.8	22.0	21.2	17.7	18.7	......	......
	10-26	16.4	16.3	20.5	22.8	25.2	24.1	18.8	17.6	20.2	......	......
	20-40	16.6	16.2	19.4	20.1	25.0	24.2	19.5	17.9	19.9	......	......
S	0-10	18.7	16.0	15.2	21.8	26.3	25.8	24.0	21.7	21.2	......	......
	10-20	14.9	14.2	16.6	22.0	26.0	25.0	19.7	16.0	19.3	......	......
	20-40	13.8	13.2	14.7	18.3	23.7	22.0	17.3	15.0	17.2	......	......
e	0-10	6.1	6.2	7.1	7.5	7.1	6.7	6.2	6.1	6.6	......	......
	10-20	6.8	8.1	8.8	7.0	7.8	7.0	6.1	6.5	7.3	......	......
	20-40	5.7	5.5	6.3	5.8	6.3	6.9	6.3	5.6	6.0	......	......
E	0-10	.163	.142	.132	.170	.240	.246	.220	.190	.188	11.7	11.3
	10-20	.204	.177	.160	.220	.312	.320	.280	.240	.239	11.5	11.2
	20-40	.238	.198	.182	.252	.360	.368	.320	.275	.274	11.5	11.1

TABLE 11.—*Tower No. 3*—Continued.

PAN 5.

Symbol.	Wind.	A. M. 2	A. M. 5	A. M. 8	A. M. 11	P. M. 2	P. M. 5	P. M. 8	P. M. 11	Mean.	Hour of mean ordinate. *a. m.*	Hour of mean ordinate. *p. m.*
t	0-10	14.0	12.0	16.0	21.4	24.2	22.0	21.7	18.0	18.9	......	......
	10-20	17.4	17.0	20.0	21.8	25.2	24.1	19.7	18.1	20.4	......	......
	20-40	17.0	16.8	18.2	20.0	24.2	24.6	20.0	18.1	19.9	......	......
S	0-10	12.3	10.3	13.2	16.5	20.7	20.4	19.2	16.0	16.1	......	......
	10-20	13.8	13.8	15.2	18.0	20.5	20.2	16.2	14.6	16.3	......	......
	20-40	12.8	12.2	13.0	16.0	19.2	18.8	14.7	13.7	15.0	......	......
e	0-10	5.4	5.8	6.8	6.6	6.1	6.0	5.4	5.2	5.9	......	......
	10-20	6.3	7.4	7.5	5.6	6.1	5.5	5.2	5.6	6.2	......	......
	20-40	4.8	4.8	5.6	4.8	5.3	5.5	5.4	5.0	5.2	......	......
E	0-10	.143	.124	.141	.182	.217	.222	.204	.175	.176	10.6	11.1
	10-20	.185	.155	.180	.240	.292	.297	.272	.228	.231	10.6	10.8
	20-40	.220	.184	.210	.277	.342	.346	.314	.262	.269	10.8	10.6

PAN 7.

											a. m.	*p. m.*
t	0-10	14.2	12.1	16.7	22.2	23.2	22.0	22.2	17.7	18.8	......	......
	10-20	16.9	17.6	21.4	22.0	23.9	23.4	19.0	17.5	20.2	......	......
	20-40	17.5	18.0	19.8	21.0	24.4	24.0	19.7	18.2	20.3	......	......
S	0-10	12.3	10.2	14.0	20.7	24.0	21.2	19.5	16.0	17.2	......	......
	10-20	14.0	14.2	17.1	20.7	22.3	21.2	17.0	14.4	17.6	......	......
	20-40	12.9	12.7	15.0	18.1	20.4	19.0	14.9	13.4	15.8	......	......
e	0-10	5.2	5.6	6.6	6.7	5.7	5.6	5.2	5.1	5.7	......	......
	10-20	6.7	7.7	7.5	6.0	6.0	5.7	5.3	5.7	6.3	......	......
	20-40	5.2	5.1	5.1	4.8	5.3	5.4	5.5	5.2	5.2	......	......
E	0-10	.154	.130	.160	.240	.283	.268	.220	.183	.205	9.8	8.8
	10-20	.205	.170	.211	.330	.395	.367	.300	.247	.278	9.8	8.9
	20-40	.246	.204	.246	.382	.470	.440	.360	.297	.331	9.7	9.2

TABLE 12.—*Tower No. 4, on western bank of reservoir. Meteorological data.*

PAN 1.

											a. m.	*p. m.*
t	0-10	12.4	11.6	17.4	21.8	24.2	22.0	18.0	15.6	17.9	......	......
	10-20	15.3	15.2	20.2	24.4	25.5	24.0	18.8	17.0	20.0	......	......
	20-40	17.9	18.0	21.7	23.9	25.0	24.0	19.0	18.3	21.0	......	......
S	0-10	15.8	16.0	18.0	21.0	21.0	19.7	17.4	16.2	18.1	......	......
	10-20	16.6	17.5	19.0	21.4	22.0	19.4	17.0	16.5	18.7	......	......
	20-40	16.0	16.7	18.2	20.2	20.2	18.3	16.7	16.0	17.8	......	......
e	0-10	6.2	6.3	7.6	7.8	7.4	7.7	6.4	6.0	6.9	......	......
	10-20	6.7	8.0	8.5	7.1	7.3	6.9	6.4	6.3	7.2	......	......
	20-40	6.4	6.4	6.0	6.1	7.0	6.7	6.1	6.0	6.3	......	......
E	0-10	.130	.125	.150	.200	.210	.198	.168	.140	.165	9.1	8.3
	10-20	.158	.155	.190	.255	.272	.258	.210	.168	.208	8.9	8.3
	20-40	.180	.174	.210	.286	.306	.290	.246	.193	.236	8.9	8.7

PAN 3.

											a. m.	*p. m.*
t	0-10	12.8	11.2	17.2	23.8	26.0	22.0	18.3	16.5	18.5	......	......
	10-20	15.4	15.0	19.0	23.6	25.9	24.0	18.0	16.6	19.7	......	......
	20-40	18.2	18.0	21.0	23.4	25.3	24.2	19.2	18.1	20.9	......	......
S	0-10	13.7	11.0	12.3	17.2	21.4	22.7	21.0	17.3	17.1	......	......
	10-20	15.8	15.6	18.0	19.7	20.7	20.6	17.8	16.2	18.0	......	......
	20-40	14.7	14.2	16.0	18.3	20.0	19.5	16.3	15.4	16.8	......	......
e	0-10	5.8	6.2	8.0	8.2	8.1	7.8	6.0	5.5	7.0	......	......
	10-20	5.9	7.0	8.0	8.3	8.4	8.0	6.0	5.4	7.1	......	......
	20-40	5.9	6.4	7.6	7.0	8.2	6.7	5.5	5.1	6.6	......	......
E	0-10	.157	.132	.150	.205	.268	.303	.260	.200	.209	11.2	10.6
	10-20	.196	.160	.194	.267	.357	.397	.340	.260	.271	11.3	10.6
	20-40	.225	.184	.220	.300	.405	.462	.388	.303	.311	11.4	10.7

PAN 5.

											a. m.	*p. m.*
t	0-10	14.2	12.2	18.2	23.8	24.7	22.0	21.0	17.7	19.2	......	......
	10-20	16.9	16.7	20.0	24.0	26.0	24.0	19.2	18.1	20.6	......	......
	20-40	18.3	18.5	21.0	23.0	25.0	24.4	19.5	18.8	21.1	......	......
S	0-10	13.0	10.6	15.6	22.2	24.4	23.0	19.7	16.2	18.1	......	......
	10-20	13.0	12.6	16.5	21.1	24.1	21.0	16.3	14.0	17.3	......	......
	20-40	12.3	12.0	14.9	19.8	22.0	19.0	15.5	13.6	16.1	......	......
e	0-10	5.7	5.8	7.2	6.9	6.4	6.1	5.9	5.7	6.2	......	......
	10-20	6.1	7.1	8.1	6.5	6.1	5.7	5.5	5.6	6.3	......	......
	20-40	5.8	6.5	6.9	6.2	5.9	5.8	5.5	5.5	6.0	......	......
E	0-10	.157	.141	.168	.260	.282	.272	.220	.183	.210	9.4	8.5
	10-20	.197	.178	.220	.350	.382	.365	.292	.240	.278	9.2	8.8
	20-40	.233	.210	.260	.405	.450	.430	.340	.282	.326	9.6	8.6

TABLE 12.—*Tower No. 4*—Continued.

PAN 7.

Symbol.	Wind.	A. M. 2	A. M. 5	A. M. 8	A. M. 11	P. M. 2	P. M. 5	P. M. 8	P. M. 11	Mean.	Hour of mean ordinate. *a. m.*	Hour of mean ordinate. *p. m.*
t	0-10	14.0	12.3	18.1	23.5	24.3	22.0	20.6	17.6	19.0	......	......
	10-20	17.0	16.5	20.3	24.3	26.0	24.0	19.2	17.8	20.6	......	......
	20-40	18.2	18.4	21.1	23.8	25.0	21.0	19.4	18.2	20.6	....	.....
S	0-10	12.3	10.9	16.2	22.5	24.2	22.2	19.0	15.9	17.9	......	......
	10-20	13.0	13.4	18.0	21.9	23.9	20.0	16.0	14.2	17.6	......	......
	20-40	12.3	12.7	16.0	20.0	20.7	18.3	15.2	13.2	16.0	......	......
e	0-10	5.9	5.8	6.8	6.6	6.0	5.8	6.0	5.9	6.1	......	......
	10-20	6.0	6.9	8.1	6.5	5.8	5.6	5.5	5.6	6.2	......	......
	20-40	5.4	5.9	6.4	6.1	5.6	5.4	5.3	5.4	5.7	......	......
E	0-10	.160	.157	.183	.284	.292	.274	.220	.180	.219	9.0	8.0
	10-20	.218	.205	.252	.394	.410	.380	.300	.253	.302	9.1	8.0
	20-40	.266	.242	.290	.460	.482	.458	.364	.302	.358	8.9	8.3

TABLE 13.—*Tower No. 5, in the irrigated field west of reservoir. Meteorological data.*

PAN 1.

											a. m.	*p. m.*
t	0-10	12.0	11.0	19.6	22.8	23.6	20.0	19.0	16.0	18.0	......	......
	10-20	15.8	15.4	21.0	24.7	24.5	19.6	18.3	17.3	19.6	......	......
	20-40	17.0	17.1	22.0	25.1	25.3	22.2	19.7	18.2	20.8	......	......
S	0-10	11.7	9.4	16.0	21.5	23.0	23.7	20.0	15.4	17.6	......	....
	10-20	16.2	16.0	16.9	21.7	24.1	21.6	17.7	16.7	18.9	......	......
	20-40	15.8	15.7	16.1	20.0	22.6	20.6	17.5	16.2	18.1	......	......
e	0-10	5.4	6.0	8.3	8.6	8.2	7.0	5.3	5.2	6.8	......	......
	10-20	5.7	6.0	7.2	8.1	7.5	6.5	5.9	5.6	6.6	......	......
	20-40	5.6	5.8	7.4	6.6	6.3	6.3	5.8	5.5	6.2	......	......
E	0-10	.103	.090	.124	.210	.262	.250	.192	.142	.172	9.6	9.2
	10-20	.133	.105	.160	.280	.340	.326	.224	.180	.218	9.3	9.2
	20-40	.150	.118	.184	.320	.386	.375	.283	.206	.253	10.2	9.1

PAN 3.

											a. m.	*p. m.*
t	0-10	13.7	17.0	19.6	23.0	24.3	21.0	21.2	17.2	19.6	......	......
	10-20	16.5	16.1	21.4	24.8	24.3	19.2	18.9	18.1	19.9	......	......
	20-40	17.7	17.0	21.0	24.8	25.2	23.0	21.6	19.2	21.2	......	......
S	0-10	12.0	9.7	16.7	22.2	24.3	23.5	20.7	16.8	18.2	......	......
	10-20	12.8	13.0	18.0	22.7	24.0	20.0	16.0	14.4	17.6	......	......
	20-40	12.2	12.4	17.0	20.7	21.8	19.0	15.7	13.9	16.6	......	......
e	0-10	5.3	5.8	7.3	7.1	6.8	6.2	5.1	4.6	6.0	......	......
	10-20	4.5	5.0	7.0	7.9	6.3	5.5	4.7	4.6	5.7	......	......
	20-40	4.2	4.7	5.2	5.5	5.6	5.4	4.6	4.5	5.0	......	......
E	0-10	.160	.128	.178	.287	.328	.312	.245	.200	.230	9.5	8.8
	10-20	.200	.160	.220	.376	.430	.408	.320	.250	.296	9.5	8.9
	20-40	.227	.180	.258	.420	.488	.472	.366	.292	.338	9.4	9.1

PAN 5.

											a. m.	*p. m.*
t	0-10	13.9	12.4	19.4	22.8	24.3	21.6	21.8	17.9	19.3	......	....
	10-20	16.8	16.0	21.0	24.2	25.0	21.7	20.0	18.7	20.4	......	......
	20-40	18.0	17.2	21.0	24.1	25.0	23.7	21.8	19.8	21.3	......	......
S	0-10	12.7	10.2	16.6	22.2	24.5	23.4	20.6	17.0	18.4	......	......
	10-20	11.8	12.0	17.3	22.6	23.2	19.6	15.8	12.5	16.8	......	......
	20-40	11.2	11.7	16.2	21.0	21.8	18.8	15.4	12.0	16.0	......	......
e	0-10	5.3	5.5	7.0	7.0	6.3	5.7	5.3	5.1	5.9	......	......
	10-20	4.7	5.5	7.0	7.3	6.4	5.4	4.8	4.7	5.7	......	......
	20-40	4.3	4.6	5.0	5.2	5.2	5.0	4.7	4.6	4.8	......	......
E	0-10	.175	.140	.186	.295	.337	.318	.262	.217	.241	9.6	9.2
	10-20	.227	.180	.242	.395	.454	.425	.352	.286	.320	9.6	9.4
	20-40	.265	.210	.290	.450	.537	.500	.408	.337	.375	9.6	9.3

PAN 7.

											a. m.	*p. m.*
t	0-10	14.7	12.7	19.4	23.0	24.3	21.8	22.2	18.5	19.6	......	......
	10-20	16.9	16.0	20.6	24.3	24.9	21.4	20.0	18.5	20.3	......	......
	20-40	17.6	17.2	21.2	24.2	25.0	23.7	21.6	19.2	21.2	......	......
S	0-10	12.7	10.8	17.2	22.5	24.0	22.8	20.0	16.4	18.3	......	......
	10-20	12.2	12.7	17.0	23.3	23.0	18.0	14.8	13.0	16.8	.....	......
	20-40	11.8	12.1	16.2	21.8	22.0	17.2	14.2	12.8	16.0	.....	......
e	0-10	5.4	5.5	6.9	6.8	6.0	5.5	5.5	5.4	5.9	......	......
	10-20	4.5	5.1	7.1	7.9	6.0	5.2	4.8	4.7	5.7	......	......
	20-40	4.2	4.6	5.2	5.3	5.1	5.0	4.7	4.6	4.8	......	......
E	0-10	.188	.154	.196	.300	.336	.310	.264	.205	.244	9.5	9.8
	10-20	.248	.200	.258	.426	.465	.428	.360	.270	.332	9.4	9.4
	20-40	.300	.240	.300	.500	.550	.510	.432	.317	.394	9.3	9.5

tower lags about two hours behind that of the air in the forenoon, and one hour in the afternoon; on tower No. 2 the dry-bulb temperature shows a strong double period, while that for the water does not have the second maximum; the vapor tension e has generally a maximum about 8 a. m., and a smaller maximum at 3 p. m., especially during the middle type of the wind velocities 10–20 kilometers per hour. The plotted curves are very interesting and they will repay careful examination, as they contain much valuable information regarding the action of the solar radiation in the lower strata. In constructing the proposed formula, the element S, the temperature of the water surface, e, the vapor pressure, and w, the wind velocity, have been incorporated into it.

The temperature of the water surface is a function of the amount of vapor in cubic centimeters v_1 which one cubic centimeter of water, v_2, will make at that temperature. The vapor pressure of the air e_d and that within one-half inch of the surface of the water e_r run in parallel lines, as shown on figs. 6–12 in Paper II of this series, so that the function of the evaporation can be built up in terms of one as well as the other, while the psychrometer will be the best instrument for use, as the floating raft thermometers are liable to get wet in the splashing water. Since the vapor pressure prevailing in the air holds close down to the water surface with no special change, it follows that the distribution of the vapor within the air, after one-half an inch has been past, goes off into the higher levels quite gradually. The first rise in vapor pressure at 8 a. m., before the heat renders the air capable of holding more vapor, marks the tendency of the evaporating vapor to change the cool morning air over the water pans.

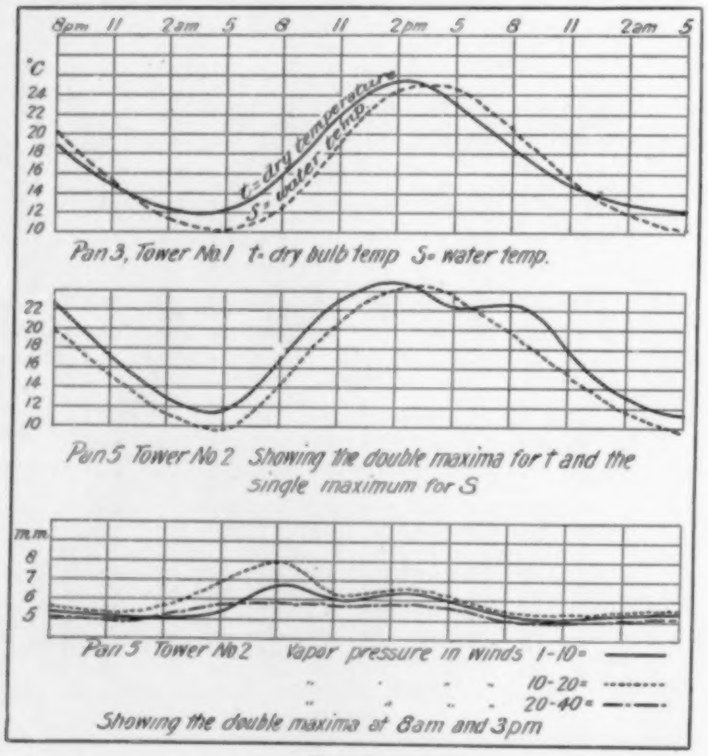

FIG. 28.

These irregularities in the meteorological data are probably due to the local conditions. In the forenoon the wind was usually feeble from the southeast; in the afternoon it was strong from the west and brought cold air from the Sierra Nevada Mountains, which flowed down the Truckee River Valley. The wind blowing over the reservoir affected the pans differently on the leeward or eastward side. The evaporation, doubtless, responded to all these characteristics, but it was not possible to disentangle all these elements in the short Reno campaign.

THE FORMULAS FOR THE EVAPORATION OF WATER.

The formula that has been commonly used in discussing the amount of the evaporation is in the form of the Dalton law.

$$E = C\,(e_s - e_d)\,(1 + Av), \tag{29}$$

where C is a constant, e_s the vapor pressure at the temperature of the water, e_d the vapor pressure at the temperature of the dew-point, A the wind constant, and v the velocity of the wind. It was shown by comparing the results of the observations at Abbassia, Boston, Fort Collins, and Nakuss that the constants are very inconsistent, and it was inferred that the formula is not satisfactory. The relations of $e_s - e_d$ are shown on figs. 6–12, on the several towers and pans for seven hours in the day, and by comparing with the evaporation, figs. 13–19 it can be seen that there is a loose relationship between them, which has been the basis of this formula. By plotting the mean values of e_s, e_d on Table 5 and the means of the evaporation on Table 6 for each hour given, the diurnal curves may be readily constructed and the Dalton law studied. On computing the so-called constant C for the seven available hours for the observations August 1–17, we find the following result, putting all the towers together:

TABLE 14.—*Values of* $\frac{1}{C} = \frac{e_s - e_d}{E}$, *and C by Dalton's law.*

Pans.	1 a. m.	5 a. m.	8 a. m.	11 a. m.	2 p. m.	5 p. m.	8 p. m.	$\frac{1}{C}$	C
6, 7	33.1	23.5	39.8	43.1	36.1	35.7	35.5	35.3	0.0283
5	34.2	25.8	40.3	44.3	37.1	40.7	44.0	38.1	0.0263
4	36.6	25.6	38.8	51.4	47.0	46.2	32.4	39.7	0.0252
3	40.5	27.7	30.3	49.8	52.3	50.1	51.4	43.2	0.0232
2	44.4	30.4	34.2	56.7	67.4	60.4	58.3	50.3	0.0199
1	50.0	40.0	45.7	53.1	52.6	59.5	65.8	52.4	0.0191
Means $\frac{1}{C}$	39.8	28.8	38.2	49.7	48.7	48.8	47.9	43.2	....
C	.0252	.0348	.0262	.0202	.0206	.0205	.0209	....	....

The table shows a variation of C increasing up the towers and a diurnal period with maximum at 5 a. m. and minimum at 2 p. m. The wind term has not been eliminated in this computation of $\frac{1}{C}$ and C, but the results are evidently contradictory. If the increase of C up the towers is due to the increase of the wind velocity, then there should be an increase in the values of C in the afternoon over C in the forenoon, because there was at Reno a strong diurnal increase in the wind from morning to afternoon, as shown in Table 8.

I have, therefore, sought in many ways for a new formula and my final form is here presented, omitting the trial discussions from this paper. The following formula seemed for a time to be of value, but it was also superseded:

$$E = C\frac{de}{dS}\,(t - d)\,(1 + Aw^2), \tag{30}$$

where $\frac{de}{dS}$ is the rate of change in the vapor pressure per degree of temperature, as given in the Smithsonian Tables (Gray), Table 165, column 2, or the Meteorological Tables, Table 43; t = the temperature of the air, d the dew-point of the air, A the wind constant, and w the wind velocity in kilometers per hour. We have finally used the formula,

$$E = C\,f(h)\,e\,\frac{de}{dS}\,(1 + Aw), \tag{31}$$

where $Cf(h)$ is a variable, a function of the height, e the vapor pressure corresponding with the dew-point of the air, $\frac{de}{dS}$ the ratio of increase of the vapor pressure to the increase of the temperature, A a wind constant, and w the wind velocity in kilometers per hour. The computations were carried on in three parts under the formulas,

(32) $E = Cf(h)\, e\frac{de}{dS} + Cf(h)\, e\frac{de}{dS}\, Aw$, so that,

(33) $E_1 = E_1 + E_1\, Aw_1$ for w_1 between 1–10 km. per hour,

(34) $E_2 = E_1 + E_1\, Aw_2$ for w_2 between 10–20 km. per hour,

(35) $E_3 = E_1 + E_1\, Aw_3$ for w_3 between 20–40 km. per hour.

Since $E_1 Aw_1$ can practically be neglected, we have,

$$Cf(h) = \frac{E_1}{e\frac{de}{dS}}. \tag{36}$$

With the value of $Cf(h)$ thus found,

$$A = \frac{E_2 - E_1}{E_1 w_2} = \frac{E_3 - E_1}{E_1 w_3}. \tag{37}$$

There are two sets of values of the evaporation for computing the wind constant A, after the observations have given curves of evaporation sorted into the three sets as determined by the wind velocities. Thus, having such evaporation curves as are found on figs. 23–27, even if they are only approximately accurate, we can proceed by this process. Construct the values of $e\frac{de}{dS}$ and divide E_1 by it for the first group with the wind 0–10 kilometers per hour. This gives values of $Cf(h)$. Then take $E_2 - E_1$, $E_3 - E_1$, construct $E_1 w_2$, $E_1 w_3$, and divide for the constant A. It will be shown that $Cf(h)$ is the variable of an interesting function, while A is constant. The following tables give the value of $Cf(h)$ as computed from the rough curves derived directly from the observations, and A likewise derived from the observations of the second and third high wind velocity groups, 10–20, 20–40. The large number of observations available for the wind group 0–10 enabled us to construct the evaporation curve E_1 quite satisfactorily, the curves E_2 and E_3 being more difficult, as already explained, on account of the excess of high winds in the afternoon hours.

The line of thought which led to this formula may be summarized as follows: The well known Clayperon formula regulates the amount of vapor that can be derived from 1 cubic centimeter of water, when the vapor and water are at a certain temperature S, as already shown in the first paper[1] of this series, formula 18, from which we have, since v_2 can be neglected in comparison with v_1,

$$\frac{de}{dS} = \frac{r_2}{v_1 S_1} \cdot \frac{41852800 \times 760}{1013235} \tag{38}$$

since $e = p_1$, the vapor pressure, and $S_1 = T_1$ in the evaporation formula, for the sake of a distinctive notation. The mechanical equivalent of heat is taken 41852800 ergs, the pressure of 1 atmosphere 76 cm., or 1013235 dynes/cm. $= B_n \rho_m g_0 = 76 \times 13.5958 \times 980.60$, r_2 is the latent heat required to vaporize water at the temperature S_1, and v_1 the volume of vapor given off, ranging from $v_1 = 211356$ cm³ at 0° C. to 1659 cm³ at 100° C. The following table gives the values of $\frac{de}{dS}$ and r_2 for various temperatures.

The vapor pressure e was selected for this reason. In evaporation from a water surface the vapor pressure near the water e_r, within half an inch of the surface, should be a direct function of the diffusion of the vapor into the air, as shown by the figs. 6–12. Since the vapor pressure e_d of the dew-point of the air follows closely the e_r of the vapor down to the water I have substituted e_d for e_r because it is more conveniently observed, and the factor which connects them, e_r/e_d, is taken up into the function $Cf(h)$. This function has not yet been solved and it may throw further light on this point. $Cf(h)$ is concerned with the rate of diffusion and mixture of the vapor, which is streaming off into the adjacent air masses, and it represents the capacity of the superincumbent air to receive the new vapor more or less rapidly. The wind term Aw simply iscreases this absorbing capacity.

[1] Monthly Weather Review, July, 1907.

TABLE 15.—*The relations of S, $\frac{de}{dS}$ and r_2.*

S	$\frac{de}{dS}$	r_2	S	$\frac{de}{dS}$	r_2
°			°		
0	0.33	606.5	16	0.86	595.2
1	0.35	605.8	17	0.91	594.5
2	0.38	605.1	18	0.96	593.8
3	0.40	604.4	19	1.02	593.1
4	0.42	603.7	20	1.07	592.3
5	0.45	603.0	21	1.14	591.6
6	0.48	602.3	22	1.20	590.9
7	0.51	601.6	23	1.26	590.2
8	0.54	600.8	24	1.33	589.5
9	0.57	600.1	25	1.40	588.8
10	0.61	599.4	26	1.48	588.1
11	0.65	598.7	27	1.56	587.4
12	0.69	598.0	28	1.64	586.7
13	0.73	597.3	29	1.72	586.0
14	0.77	596.7	30	1.80	585.3
15	0.81	595.9			

TABLE 16.—*Computation of the term $Cf(h)$. Tower No. 1, pan 1.*

$$Cf(h) = \frac{E_1}{e\frac{de}{dS}}$$

Formula.	8 p. m.–1 a. m.	1–5 a. m.	5–8 a. m.	8–11 a. m.	11 a. m.–2 p. m.	2–5 p. m.	5–8 p. m.	Means.
S	15.8	10.8	10.7	15.4	22.8	24.9	22.7	
$\frac{de}{dS}$	0.85	0.64	0.64	0.83	1.25	1.39	1.24	
e	5.6	5.7	6.5	6.7	6.7	6.4	5.9	
$e\frac{de}{dS}$	4.8	3.6	4.2	5.6	8.4	8.9	7.3	
E_1	.097	.088	.138	.245	.300	.255	.162	
$Cf(h)$	.020	.025	.033	.044	.036	.029	.022	.030

TABLE 17.—*Computation of the mean diffusion function $Cf(h)$ from the three-hour observations.*

Pans.	8 p. m.–1 a. m.	1–5 a. m.	5–8 a. m.	8–11 a. m.	11 a. m.–2 p. m.	2–5 p. m.	5–8 p. m.	Means.
TOWER 1.								
1.........	.020	.025	.033	.044	.036	.029	.022	.030
3.........	.028	.028	.021	.040	.041	.033	.027	.031
5.........	.030	.031	.031	.039	.046	.037	.031	.035
7.........	.032	.035	.035	.039	.049	.041	.031	.037
TOWER 2.								
1.........	.029	.023	.023	.024	.026	.024	.021	.024
3.........	.028	.031	.035	.027	.033	.024	.024	.029
5.........	.035	.037	.035	.033	.034	.034	.035	.035
7.........	.038	.039	.037	.038	.046	.030	.030	.037
TOWER 3.								
1.........	.014	.016	.021	.020	.014	.018	.014	.017
3.........	.024	.024	.025	.024	.022	.022	.022	.024
5.........	.034	.033	.033	.033	.035	.028	.036	.033
7.........	.038	.034	.037	.032	.038	.031	.047	.037
TOWER 4.								
1.........	.025	.024	.024	.024	.024	.024	.025	.024
3.........	.031	.031	.032	.031	.031	.020	.030	.031
5.........	.035	.039	.038	.033	.036	.037	.036	.036
7.........	.038	.040	.038	.037	.040	.043	.039	.039
TOWER 5.								
1.........	.028	.036	.030	.021	.020	.020	.022	.025
3.........	.034	.044	.037	.031	.036	.035	.033	.036
5.........	.036	.045	.044	.037	.041	.038	.035	.039
7.........	.040	.043	.041	.039	.042	.043	.041	.041

The values of the temperature are taken from the curve for the twenty-four hours at the mean value for the intervals given, to conform to the integration, and practically it is taken for the time at the mean of the interval. They can be found approximately on Table 9. E_1 is taken at the end of the interval on the curve, as drawn thru the observations; de/dS is taken from Table 15. Similar computations for pans 1, 3, 5, and 7, on towers 1, 2, 3, 4, and 5, are collected in Table 17.

TABLE 18.—*Computation of the wind constant A.*

$$A=\frac{E_2-E_1}{E_1\,w_2}=\frac{E_3-E_1}{E_1\,w_3}.$$

Pans.	8 p. m.-1 a. m.	1-5 a. m.	5-8 a. m.	8-11 a. m.	11 a. m.-2 p. m.	2-5 p. m.	5-8 p.m.	Means
TOWER 1.								
1 w_2 ..	0.018	0.023	0.021	0.017	0.015	0.015	0.022	0.019
w_3 ..	.023	.037	.024	.024	.020	.021	.020	.024
3 w_2 ..	.020	.024	.018	.015	.011	.016	.018	.017
w_3 ..	.022	.017	.024	.018	.016	.019	.019	.019
5 w_2 ..	.021	.019	.012	.013	.012	.015	.013	.015
w_3 ..	.021	.021	.018	.014	.013	.016	.015	.017
7 w_2 ..	.014	.016	.018	.011	.009	.014	.013	.014
w_3 ..	.016	.017	.020	.014	.010	.013	.017	.015
TOWER 2.								
1 w_2 ..	.016	.022	.022	.024	.020	.011	.012	.018
w_3 ..	.020	.026	022	.028	.021	.015	.012	.021
3 w_2 ..	.019	.027	.023	.020	.014	.010	.009	.017
w_3 ..	.022	.026	.028	.027	.019	.014	.015	.022
5 w_2 ..	.011	.020	.022	.020	.015	.009	.007	.015
w_3 ..	.013	.024	.031	.025	.018	.014	.013	.020
7 w_2 ..	.017	.028	.022	.015	.013	.012	.011	.017
w_3 ..	.017	.029	.026	.020	.018	.017	.012	.020
TOWER 3.								
1 w_2 ..	.015	.015	.021	.025	.028	.019	.015	.020
w_3 ..	.018	.019	.030	.031	.034	.022	.019	.025
3 w_2 ..	.010	.014	.012	.012	.012	.011	.011	.012
w_3 ..	.012	.014	.018	.019	.015	.014	.015	.015
5 w_2 ..	.012	.020	.018	.020	.020	.019	.013	.017
w_3 ..	.016	.022	.024	.025	.024	.022	.015	.021
7 w_2 ..	.014	.018	.013	.010	.013	.016	.011	.014
w_3 ..	.016	.020	.015	.014	.017	.016	.013	.016
TOWER 4.								
1 w_2 ..	.010	.019	.023	.016	.009	.009	.012	.014
w_3 ..	.012	.024	.027	.019	.013	.011	.013	.017
3 w_2 ..	.016	.018	.018	.016	.015	.014	.010	.015
w_3 ..	.019	.022	.024	.022	.018	.016	.012	.019
5 w_2 ..	.014	.015	.014	.015	.014	.014	.011	.014
w_3 ..	.016	.018	.019	.021	.018	.019	.012	.018
7 w_2 ..	.015	.016	.015	.011	.015	.016	.013	.014
w_3 ..	.016	.016	.018	.019	.019	.018	.015	.017
TOWER 5.								
1 w_2 ..	.012	.013	.015	.020	.019	.014	.013	.015
w_3 ..	.015	.019	.025	.027	.024	.018	.016	.021
3 w_2 ..	.013	.016	.017	.018	.012	.012	.017	.015
w_3 ..	.014	.015	.021	.021	.014	.013	.017	.016
5 w_2 ..	.014	.020	.017	.018	.011	.015	.013	.015
w_3 ..	.017	.021	.022	.018	.013	.016	.015	.017
7 w_2 ..	.014	.026	.025	.014	.012	.013	.011	.016
w_3 ..	.014	.022	.023	.017	.013	.014	.013	.017

Mean A-constant, Tower 1, 0.0175
2, .0188
3, .0175
4, .0160
5, .0165

Mean .0173

Adopted A-constant 0.0175

With this value of the A-constant, and the mean values of the C-function given in Table 17, the values of E_1, E_2, E_3, which appear in Tables 9-13 and in figs. 23-27, were computed for the 4 pans on the 5 towers.

THE DIFFUSION COEFFICIENT $Cf(h)$.

I will call the variable term C the diffusion coefficient till the complete elucidation of the function shall suggest a better name. In order to bring out some of its characteristics, the values of C obtained for the pans on the several towers will be plotted on fig. 29. The depression of the curves in the middle of the reservoir, and the progressive spacing between them, suggests that they are arranged on a geometric ratio, counting the distances from a *maximum* line C_0 to be determined by computation. The fall of the line C_4 at tower No. 5 corresponding with the lowest pan in the alfalfa field is due to the irrigation of the ground, which makes the lower stratum act like the water of the reservoir to some extent. The dotted line eliminates that feature. By a few trials I have determined the C_0 line which conforms with this theory, as follows:

TABLE 19.—*The geometrical ratio* $\rho=\varpi_{n+1}/\varpi_n$.

Towers.	5		4		3		2		1	
		ϖ_n		ϖ_n		ϖ_n		ϖ_n		ϖ_n
C_0	.044		.044		.043		.042		.041	
		3		5		6		5		4
C_1	.041		.039		.037		.037		.037	
		5		8		11		7		6
C_2	.039		.036		.032		.035		.035	
		8		13		18		13		9
C_3	.036		.031		.025		.029		.032	
		13		20		26		18		11
C_4	.031		.024		.017		.024		.030	
Ratio $\frac{\varpi_{n+1}}{\varpi_n}$		1.67 1.60 1.63		1.60 1.63 1.54		1.83 1.64 1.44		1.40 1.86 1.39		1.50 1.50 1.22
Mean ρ		1.63		.1.59		1.64		1.55		1.41

$$\text{Mean}\ \frac{\varpi_{n+1}}{\varpi_n}=\rho=1.55.$$

Assume the line C_0 and take successive differences between C_0 and the lower curves C_0-C_1, C_0-C_2, C_0-C_3, C_0-C_4, C_0-C_5. Divide these differences in succession

$$\rho=\frac{\varpi_{n+1}}{\varpi_n}=\frac{\varpi_2}{\varpi_1}=\frac{\varpi_3}{\varpi_2}=\frac{\varpi_4}{\varpi_5}=1.55. \tag{39}$$

Assume coordinate values for the lower line C_4, and take an assigned value for C_0; subtract C_4 from C_0 to obtain C_0-C_4, and then divide by 1.55 in succession to adjust the assumed C_0.

TABLE 20.—*Adjustment of the C-function to the geometrical law.*

COMPUTATION OF THE ADJUSTED ΔC.

Symbol.	C	ΔC	C	ΔC	C	ΔC	C	ΔC	C	ΔC
C_0	.0430	.....	.0430	.....	.0430	.....	.0430	.....	.0430	.....
C_1	.....	.0032	.....	.0051	....	.0070	.....	.0054	.....	.0038
C_2	....	.0050	.....	.0079	.....	.0108	.....	.0083	.....	.0058
C_3	.....	.0077	.....	.0123	.....	.0168	.....	.0129	.....	.0090
C_4	.0310	.0120	.0240	.0190	.0170	.0260	.0230	.0200	.0290	.0140

COMPUTATION OF THE ADJUSTED C.

Symbol.	C	ΔC	C	ΔC	C	ΔC	C	ΔC	C	ΔC
C_0	.0430	.....	.0430	.....	.0430	.....	.0430	.....	.0430	.....
C_1	.0398	.....	.0379	.....	.0360	.....	.0376	.....	.0392	.....
C_2	.0380	.....	.0351	.....	.0322	.....	.0347	.....	.0372	.....
C_3	.0353	.....	.0307	.....	.0262	.....	.0301	.....	.0340	.....
C_4	.0310	.....	.0240	.....	.0170	....	.0230	.....	.0290	.....

To compute the adjusted ΔC proceed as follows: Assume for C_0 the mean value .0430 for each tower, and for C_4 in succession .0310, .0240, .0170, .0230, .0290. Take the differences .0120, .0190, .0260, .0200, .0140, and divide in succession up the column by 1.55. Thus .0077=.0120/1.55, .0050=.0077/1.55, .0032=.0050/1.55. Then subtract ΔC from C_0 in succession for C_1, C_2, C_3, C_4. Fig. 30 contains the adjusted values of C and may be compared with fig. 29, which certainly suggests this geometrical law,

$$C_n=C_0-(C_0-C_1)\left(\frac{\varpi_{n+1}}{\varpi_n}\right)^n=C_0-\Delta C_1\rho^n. \tag{40}$$

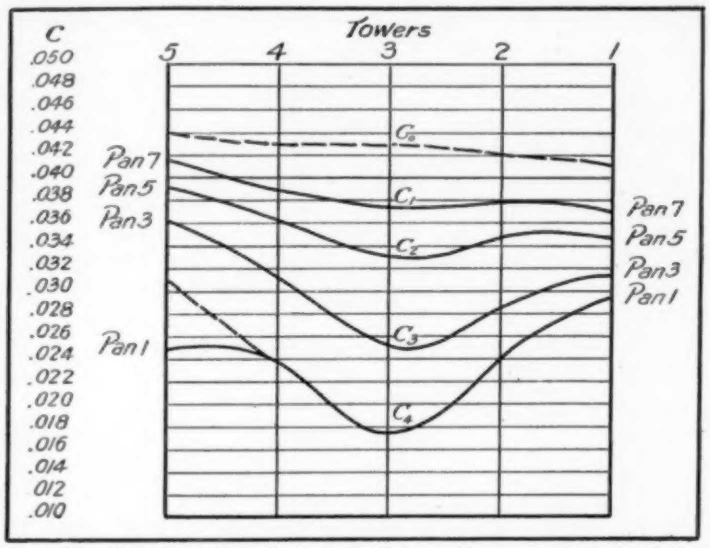

FIG. 29.—The C-coefficient as derived from the computations of the observations.

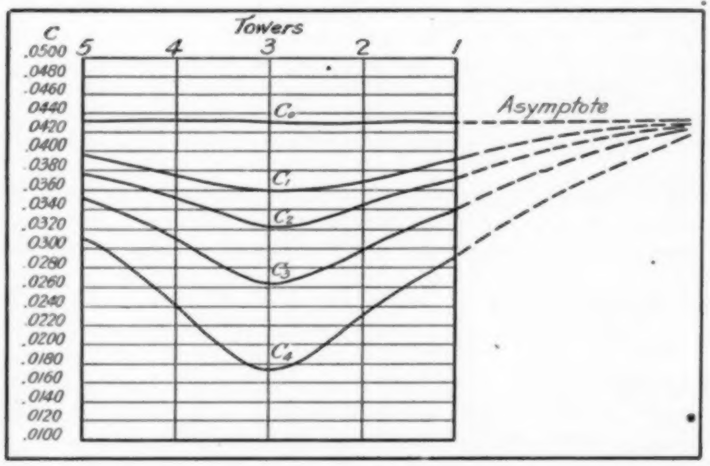

FIG. 30.—The C-coefficient adjusted by the law of a geometrical ratio.

It is, also, very desirable to extend the C-function to heights beyond the reach of observations on the towers, and it can apparently be readily done. The observations on the pans 1, 3, 5, and 7 were taken at the following approximate heights, the small variations having no influence on the amount of the evaporation, as stated in the preceding pages:

Pan 7, 12 meters, 39.4 feet.
Pan 5, 6 meters, 19.7 feet.
Pan 3, 3 meters, 9.8 feet.
Pan 1, 0 meters, 0.0 feet.

THE C-COEFFICIENT.

The coefficient C is a variable with the height, and there is evidence that it has a small diurnal and annual period at the same place. The further discussion of this term must be left for the campaign at the Salton Sea.

Now it follows that this series of heights can be represented by a simple formula,

$$h_n = 3 \times 2^{n-2}, \tag{40}$$

not counting the height of the first pan, since,

$$h_2 = 3 \times 2^{2-2} = 3 \times 1 = 3, \text{ for pan (3)},$$
$$h_3 = 3 \times 2^{3-2} = 3 \times 2 = 6, \text{ for pan (5)},$$
$$h_4 = 3 \times 2^{4-2} = 3 \times 4 = 12, \text{ for pan (7)},$$
$$h_5 = 3 \times 2^{5-2} = 3 \times 8 = 24.$$

Hence, the heights can be controlled by a geometrical ratio law of which 2 is the factor. We, therefore, construct the reciprocal of the ρ-ratio, and take the log of $1/\rho$ for the height having the number 2, at which point this law begins to apply. Table 21 contains the computation. Take $\rho = 1.55$ find its logarithm and reciprocal, and subtract the log $1.55 = 0.19033$ in succession up to n times. Take the values of C_0 corresponding to a height $h = \infty$, which is to be the asymptote to the group of C curves in fig. 30; also, C at the height $h = 0$, on the water and land surfaces. Take the difference $\Delta C = C_0 - C$ and its logarithm. Add this in succession to the series of log $1/\rho$. The next section contains the corresponding numbers ΔC at the successive heights, and the last section the corresponding values of C_n, formed by subtracting ΔC_n from C_0 in succession. The four lines at the head of this table are identical with those in Table 20, the others constituting the extension required.

Plotting these values of C_n to the argument h_n on fig. 31, we have the structure of the C-function relative to the height. The maximum value of C is .0430, *which corresponds to a maximum evaporation outside the vapor blanket covering the reservoir*, and it is at some asymptotic distance. Practically the curves approach this value at about 40 meters = 131 feet, and this is the height at which the blanket fails to have any influence. The chief effect is within 60–70 feet of the surface. This method of computing the depth of a vapor blanket is of great practical value in studying these problems, as can be easily perceived, because it renders unnecessary the construction of lofty towers, since the initial values for the formula can be found within 40 feet of the surface.

TABLE 21.—*Extension of the C function to the heights* $h_n = 3 \times 2^{n-2}$.

Tower.		No. 5.	No. 4.	No. 3.	No. 2.	No. 1.	Height.
I. COMPUTATION OF LOG $1/\rho$ FOR SUCCESSIVE POWERS OF 2.							
ρ				1.55			
log ρ		Same as No. 3.	Same as No. 3.	0.19033	Same as No. 3.	Same as No. 3.	$h_n = 3 \times 2^{n-2}$
log $1/\rho$	2			9.80967			
	3			9.61934			
	4			9.42901			
	5			9.23868			
	6			9.04835			
	7			8.85902			
	8			8.66769			
	9			8.47736			
	10			8.28703			
II. COMPUTATION OF LOG ΔC FOR SUCCESSIVE HEIGHTS.							
C_0 at $h = \infty$		.0430	.0430	.0430	.0430	.0430	....
C at $h = 0$		.0310	.0240	.0170	.0230	.0290	....
ΔC		.0120	.0190	.0260	.0200	.0140	....
log ΔC_n	1	8.07918	8.27875	8.41497	8.30103	8.14613	0
	2	7.88885	8.08842	8.22464	8.11070	7.95580	$3 \times 2^0 = 3$
	3	7.69852	7.89809	8.03431	7.92037	7.76547	$3 \times 2^1 = 6$
	4	7.49819	7.70776	7.80498	7.73004	7.57514	$3 \times 2^2 = 12$
	5	7.30786	7.51743	7.65365	7.53971	7.38481	$3 \times 2^3 = 24$
	6	7.12753	7.32710	7.46332	7.34938	7.19448	$3 \times 2^4 = 48$
	7	6.93820	7.13777	7.27399	7.16005	7.00515	$3 \times 2^5 = 96$
	8	6.74687	6.94644	7.08266	6.96873	6.81382	$3 \times 2^6 = 192$
	9	6.55654	6.75611	6.89233	6.77839	6.62349	$3 \times 2^7 = 384$
	10	6.36621	6.56578	6.70200	6.58806	6.43316	$3 \times 2^8 = 768$
III. COMPUTATION OF ΔC FOR SUCCESSIVE HEIGHTS.							
ΔC_n	1	.0120	.0190	.0260	.0200	.0140	0
	2	.0077	.0123	.0168	.0129	.0090	3
	3	.0050	.0079	.0108	.0083	.0058	6
	4	.0032	.0051	.0070	.0054	.0038	12
	5	.0020	.0033	.0045	.0035	.0024	24
	6	.0013	.0021	.0029	.0022	.0016	48
	7	.0009	.0014	.0019	.0014	.0010	96
	8	.0006	.0009	.0012	.0009	.0007	192
	9	.0004	.0006	.0008	.0006	.0004	384
	10	.0002	.0004	.0005	.0004	.0003	768
IV. COMPUTATION OF C FOR SUCCESSIVE HEIGHTS.							$h_n = 3 \times 2^{n-2}$
C_n	1	.0310	.0240	.0170	.0230	.0290	0
	2	.0353	.0307	.0262	.0301	.0340	3
	3	.0380	.0351	.0322	.0347	.0372	6
	4	.0398	.0379	.0360	.0376	.0392	12
	5	.0410	.0397	.0385	.0395	.0406	24
	6	.0417	.0409	.0401	.0408	.0414	48
	7	.0421	.0416	.0411	.0416	.0420	96
	8	.0424	.0421	.0418	.0421	.0423	192
	9	.0426	.0424	.0422	.0424	.0426	384
	10	.0428	.0426	.0425	.0426	.0427	768

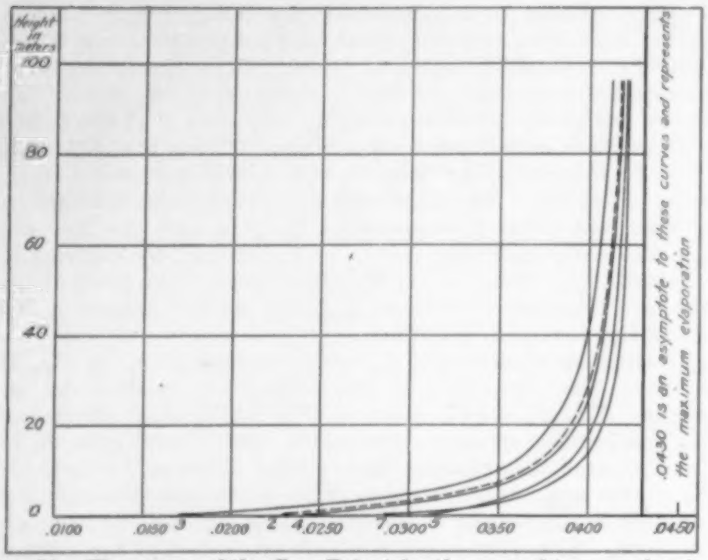

FIG. 31.—The curves of the *C*-coefficient for the several towers, showing the great variability in the lower layers of the atmosphere. The stations at Mammoth Tank and Edom are designed to give the value of the *C*-coefficient as a maximum, while the stations at Indio, Mecca, and Brawley will give values of *C* in the irrigated districts, and the towers in the Salton Sea will give values for water surfaces and the adjacent strata of the atmosphere. The relation of these coefficients to a broad water area which is evaporating must be studied before the integral of the loss of water over a sea, a lake, or a reservoir can be found. This is a problem of much difficulty to reduce to a simple practical form.

SUMMARY.

In reviewing the outcome of the Reno work I feel satisfied with the wind coefficient A, with the use of the coefficient de/dS, and with the fact that $Cf(h)$ has been shown to be a very complex variable. The introduction of the vapor pressure e in that formula is probably incomplete, and it may well be that the elucidation of the function C will give it a very different setting. It will be necessary to build three or four towers in the Salton Sea, and possibly one on a small island near the southern end of the lake; the stations at Edom, Indio, Mecca, Brawley, and Mammoth Tank will have observing stands to carry one pan 10 feet above the ground, while another pan is on the surface. The size of the pans makes an insignificant difference in the amount of evaporation, when they are under identical local conditions. We used six improved Piche evaporimeters at Reno, and compared them directly with the evaporation from the pans at the same elevations and under like conditions, with the hope of substituting these more sensitive instruments for the large pans. They consist of a volumetric tube about 30 cm. long carrying 40 scale divisions, the tube being 1.8 cm. in diameter. The glass was blown so that a small Mariotte tube, in communication with the free air, extended down the middle to within 1 cm. of the bottom. A circular glass plate 8 cm. in diameter was covered by a good filter paper and held against the bottom of the tube by a spring and screw. The water flows from the tube thru the filter paper and evaporates from the *upper* surface only, the air pressure being nearly constant on the inside by reason of the Mariotte tube admitting air to the upper part as the water falls. The area of the paper is 50.27 cm^2, and of the tube 2.54 cm^2, so that the water evaporates from 47.73 cm^2 of the paper. At Reno the evaporation was rapid enough to exhaust the water in about three hours in strong winds during the afternoon, so that the rate of the fall of the water was about 55 times greater in the tube than in the open pans, an advantage in accurate reading, *provided the ratio is a constant.* Table 22 shows that this ratio has a marked diurnal period. It is not probable that the measurements of the water-fall in the pans are seriously in error, and we must conclude that the action of the filter paper in conveying water to the edge and losing it by evaporation is variable. In high winds, 25 to 35 km. per hour, the edges of the paper dried out faster than the water could travel thru the paper from the feeding tube to the edge, 3 cm. distant, so that the paper often became detached from the glass plate in high winds. In the early morning hours the evaporation was not fast enough for the pans, and the fiber of the paper may have retained the vapor particles in a thin skin longer than the water surface in the pan under similar conditions. It was a disappointment to find that this promising piece of apparatus must receive further study and development.

TABLE 22.—*Ratio of evaporimeter to water-fall in pans.*

$$\text{Ratio} = \frac{\text{Fall of water in the evaporimeter tube}}{\text{Fall of water in the open pan.}}$$

Intervals.	1 a.m.	5 a.m.	8 a.m.	11 a.m.	2 p.m.	5 p.m.	8 p.m.	Day.
Evaporimeter No. 1:								
Aug. 5-10	71	51	41	75	48	51	44	54.4
12-17	62	47	12	35	48	58	56	45.4
Pans 1, 2. 19-24	79	41	14	48	63	46	68	51.3
26-31	60	25	15	41	89	61	53	49.3
Sept. 2-7	49	26	17	58	61	49	49	44.1
9-14	72	55	29	44	73	50	71	56.3
Means	65.5	41.0	21.3	50.2	63.7	52.5	56.8	50.1
Evaporimeter No. 2:								
Aug. 5-10	63	47	58	84	103	95	85	76.5
12-17	107	41	18	68	88	101	107	75.1
Pan 3. 19-24	109	47	24	64	58	74	69	63.6
26-31	68	23	19	64	82	63	65	54.9
Sept. 2-7	43	31	9	42	85	43	39	41.7
9-14	70	54	21	43	52	42	66	49.7
Means	76.7	40.5	24.8	60.2	78.0	69.7	71.8	60.3
Evaporimeter No. 3:								
Aug. 5-10	59	43	44	64	79	62	71	60.3
12-17	86	45	23	55	62	72	86	61.5
Pan 4. 19-24	95	59	34	74	67	58	91	68.3
26-31	89	59	46	61	72	67	81	67.9
Sept. 2-7	59	42	26	47	66	57	63	51.4
9-14	70	56	35	67	65	53	74	60.0
Means	75.4	50.7	34.7	61.3	68.5	61.5	77.7	61.6
Evaporimeter No. 4:								
Sept. 2-7	68	31	19	51	67	65	71	53.1
Pan 5. 9-14	53	54	37	54	78	71	73	60.0
Means	60.5	42.5	28.0	52.5	72.5	68.0	72.0	56.5
Evaporimeter No. 5:								
Sept. 2-7	77	33	29	48	71	64	64	55.1
Pan 6. 9-14	60	45	39	64	71	50	53	54.6
Means	68.5	39.0	34.0	56.0	71.0	57.0	58.5	54.9
Evaporimeter No. 6:								
Sept. 2-7	70	28	24	42	64	59	69	50.9
Pan 7. 9-14	77	43	38	58	64	53	64	56.7
Means	73.5	35.5	31.0	50.0	64.0	56.0	66.5	53.8
Means of all.	70.5	41.5	29.0	55.0	69.6	60.8	67.2	56.2

Since there is evaporation from 47.73 cm^2 of the paper and the mean ratio is 56.2 it follows that the evaporation averages 1.177 times faster from each cm^2 of paper to each cm^2 of the free water surface. It is possible that some method can be devised to serve more uniformly than the paper acting as a conductor of the water.

It is very important to devise self-registering apparatus, because the labor of three-hourly observations by personal work is such as to exclude evaporation from general study, except by rough summaries, as the total daily amounts, wherein the process is entirely obscured from analysis. These instruments should include a vapor pressure apparatus, and an evaporation apparatus, as well as a thermometer for the water surface, besides the common thermograph. As a practical matter, in order to save the great labor of three-hourly observations in default of self-registering apparatus, it is desirable to find a single three-hour observation of the evaporation which, multiplied by the factor 8, will be equivalent to that amount occurring in twenty-four hours. In Tables 9–13 is given the mean of the eight three-hourly amounts of the evaporation; multiply

this by 8 for the total amount in twenty-four hours in centimeters, 1 cm=0.394 inch. Plotting this value on the curves of figs. 23-27 and noting the times of occurrence of this ordinate, it is found to average about 10:30 a. m. and 10 p. m. That is to say, if a measure of the height of the water in the pan be made at 7:30 a. m., and another at 10:30 a. m., the difference multiplied by 8 will be closely the total evaporation for the day. This rule holds at Reno, Nev., during the summer, but it should be verified in other localities. Furthermore, in the arid regions of the West it seems probable that a lake or reservoir evaporates about five-eighths as fast as an isolated pan placed outside the vapor blanket; in other words, this vapor blanket seems to conserve about three-eighths of the water that would otherwise be lost by the evaporation. It is important that similar experiments with towers be made in the central and eastern portions of the United States, in the prevailing damp climates, to discover whether similar rules can be applied in practise. A careful campaign on the theory of evaporation is evidently demanded to elucidate this complex function of the evaporation of water in the open air, and it is probable that several years will be required in order to bring it to a satisfactory conclusion.

THE WEATHER OF THE MONTH.

By Mr. P. C. Day, Assistant Chief, Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure for February, 1908, over the United States and Canada, is graphically shown on Chart VI, and the average values and departures from the normal are shown for each station in Tables I and III.

February mean pressure partook generally of the usual winter type, a ridge of high pressure, 30.10 to 30.15 inches, stretching from the east Florida coast northwestward to the upper Missouri Valley and thence southwesterly to the middle Pacific coast, diminishing gently to about 30.00 inches over the Canadian Maritime Provinces, the southern portions of Arizona and New Mexico, and over northwest Washington and British Columbia.

There was a decided increase in pressure from that of January, 1908, over the districts east of the Rocky Mountains, while over the Plateau districts a compensating decrease occurred.

Pressure averaged above the normal over practically all districts of the United States and Canada, except over the Pacific coast and the central Mississippi Valley.

The building up of the area of high pressure over the upper Missouri Valley and generally along the northern border brought nearly all districts east of the Missouri and Mississippi valleys under the influence of westerly and northwesterly surface winds, and over the northern tier of States from North Dakota eastward, including the Lake region, New England, and the north Atlantic coast, the month was unusually stormy, the average wind velocity at many points exceeding the normal from 30 to 50 per cent.

The extension of the south Atlantic high area westward over Texas and the Southwest gave southerly winds from the lower Mississippi Valley westward over Texas, and generally over the region from the Rocky Mountains to the Pacific. Over these districts storms were remarkably infrequent and the monthly wind movement was correspondingly less than the average.

TEMPERATURE.

The average temperature remained above the normal, as during the preceding months since October, inclusive, over most of the districts west of the Mississippi Valley, only a small area over the lower Colorado Valley and the central and south Pacific coasts showing temperatures slightly below the average.

Over the entire Missouri Valley and northern slope and Plateau districts the average temperature ranged from 4° to 8° above the normal, and across the border in the Canadian Northwest Provinces unusually mild weather was the rule thruout the month.

From the Missouri Valley westward to the Pacific and southward over most of the Great Plains, mountain, and Plateau districts the mean temperature has remained above the normal during the past five months, and the accumulated excess during that period ranges from about 2° daily in the more southern portions to more than 7° daily over portions of Montana and the Dakotas.

Over the districts east of the Mississippi the average temperature was generally below the normal, the deficiency ranging from 3° to 5° daily over the Appalachian Mountain region, east Gulf States, and the Florida Peninsula.

During the first few days of the month a cold wave of considerable severity prevailed over the northern Rocky Mountain and Plateau districts, extending into the Great Plains and central valleys, but aside from the above no extended or severe periods of cold occurred over those districts.

The continuous discharge of cold winds from the Hudson Bay region over the lower Lakes and New England gave to those districts frequent and severe periods of cold.

Over the northern portions of New York and New England minimum temperatures from 30° to 40° below zero were recorded, the lowest reported in those districts for many years.

Temperatures as low as −40° were recorded also over the mountain districts of southeastern Idaho and northwestern Wyoming on the 1st and 2d, but these readings were probably due to the intense nocturnal radiation possible in the clear, dry atmosphere of that region, rather than to the intensity of the advancing cold area.

Altho temperatures were moderate over most of the northern districts, several periods of cold weather, for the latitude, penetrated into the Gulf and south Atlantic coast districts, and freezing temperatures with killing frosts occurred on numerous dates, extending to the immediate coast line and to the interior districts of central Florida.

PRECIPITATION.

The distribution of precipitation during February, 1908, is graphically shown on Chart IV by appropriate shading or by figures representing the actual amount of fall over districts the topography of which is too varied to admit of approximately correct shading.

The precipitation over the lower Ohio and middle Mississippi valleys was comparatively heavy, ranging from 6 to 10 inches; over the remaining districts east of the Mississippi River the amounts were very generally from 2 to 4 inches, except over southern Florida, where the fall averaged but slightly above 1 inch.

From the Missouri Valley and Great Plains westward over the Rocky Mountain and Plateau districts the amount of fall was generally less than 1 inch, except over portions of Arizona and New Mexico, where amounts from 2 to 6 inches were recorded.

Comparatively heavy precipitation, from 5 to 10 inches, occurred over the mountains near the coast of California, Oregon, and Washington, and also over the high elevations of the Sierra and Cascade ranges in those States.

Along the immediate Atlantic coast from New England to Florida, over the Appalachian district from Maryland southward, and the east Gulf States, there was a general deficiency in precipitation ranging from 1 inch to 3 inches.

Along the Rio Grande Valley, over western Texas and the central and northern portions of the mountain, Plateau, and Pacific coast districts, there was a general but small deficiency in the monthly amounts of precipitation.

Over the lower Lakes, the Ohio and lower Mississippi valleys, eastern Texas and portions of Arizona, the precipitation ranged from 2 to 5 inches above the normal, and there was a small excess over the greater portions of New England, the Middle Atlantic States, the upper Lakes, the Missouri and upper Mississippi valleys, the Great Plains and portions of New Mexico, southern California, and northern Washington.

Over California there was an unusual lack of precipitation from the 10th to 27th, but general rains on the last two days brought the monthly amounts well up to the average. Over the remaining districts the precipitation was generally well distributed during the various periods of the month.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	12	22.9	− 3.1	− 0.8	− 0.4
Middle Atlantic	16	29.4	− 3.7	− 2.4	− 1.2
South Atlantic	10	44.0	− 3.9	− 3.9	− 2.0
Florida Peninsula*	8	58.8	− 3.0	− 2.0	− 1.0
East Gulf	11	47.6	− 3.3	− 3.4	− 1.7
West Gulf	10	50.3	+ 1.1	+ 4.6	+ 2.3
Ohio Valley and Tennessee	13	34.6	− 1.6	− 0.8	− 0.4
Lower Lake	10	21.2	− 3.3	− 1.9	− 1.0
Upper Lake	12	19.4	+ 0.4	+ 4.4	+ 2.2
North Dakota*	9	15.1	+ 8.0	+19.8	+ 9.9
Upper Mississippi Valley	15	27.0	+ 2.4	+ 7.7	+ 3.8
Missouri Valley	12	29.3	+ 4.9	+13.8	+ 6.9
Northern Slope	9	24.9	+ 3.7	+10.5	+ 5.2
Middle Slope	6	37.6	+ 5.2	+12.3	+ 6.2
Southern Slope*	7	45.8	+ 2.8	+ 7.2	+ 3.6
Southern Plateau*	12	42.9	+ 0.2	+ 3.0	+ 1.5
Middle Plateau*	10	31.0	+ 0.8	+ 3.6	+ 1.8
Northern Plateau*	12	33.2	+ 3.0	+ 6.0	+ 3.0
North Pacific	7	41.5	+ 0.8	+ 3.3	+ 1.6
Middle Pacific	8	48.7	− 0.9	+ 0.8	+ 0.4
South Pacific	4	52.0	− 0.6	+ 1.9	+ 1.0

* Regular Weather Bureau and selected cooperative stations.

In Canada.—Director R. F. Stupart says:

The temperature was very slightly below the average in British Columbia, considerably above it from the Rocky Mountains to the Lake Superior region, much below the average from the Georgian Bay district eastward as far as the eastern part of the Province of Quebec, and above it in nearly all portions of the Maritime Provinces. In the Western Provinces the positive departures ranged from 8° to 12° and in the Maritime Provinces from 1° to 4°. The negative departures in Ontario ranged from 2° to 6° and in Quebec from 1° to 3°.

The precipitation was much in excess of the average over the greater portion of Canada, in most districts from 50 to 100 per cent more than the normal. It was, however, from 20 to 40 per cent deficient in Alberta, and there were also deficiencies of about 20 per cent very locally in British Columbia, Manitoba, and the southwestern portion of the Maritime Provinces.

In British Columbia at the close of the month the ground was bare of snow in portions of the lower levels of southern districts, whilst in the north and higher levels there was a deep covering.

Southern Alberta was bare of snow, while elsewhere the depth was almost generally about 3 inches. A depth of from 3 inches in the south to 12 inches in the north was reported from Saskatchewan. Manitoba was covered with snow to a depth of about 5 inches.

In Ontario the depth increased eastward from about 4 inches in the Rainy River district, and northward from 10 inches and over along the shores of the lower Lakes, to from 30 to 46 inches in the Georgian Bay, Temiskaming, and Ottawa Valley districts.

The western portion of Quebec was snow-covered to a depth of from 30 to 50 inches, while the Gaspe Peninsula had 24 inches.

In the Maritime Provinces the depth decreased from nearly 20 inches in the northern parts until there was only a trace on the ground in southern New Brunswick and in Nova Scotia.

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		Inches.	Inches.
New England	12	3.92	115	+0.5	−0.1
Middle Atlantic	16	3.53	113	+0.5	+0.3
South Atlantic	10	3.58	86	−0.6	−0.3
Florida Peninsula*	8	2.15	66	−1.1	−1.3
East Gulf	11	4.98	102	+0.1	+0.4
West Gulf	10	3.27	118	+0.5	−0.6
Ohio Valley and Tennessee	13	4.31	116	+0.6	−0.7
Lower Lake	10	3.90	156	+1.4	+0.7
Upper Lake	12	2.56	145	+0.8	+0.3
North Dakota*	9	1.20	240	+0.7	+0.3
Upper Mississippi Valley	15	2.72	144	+0.9	+0.1
Missouri Valley	12	2.13	188	+1.0	+0.5
Northern Slope	9	0.78	89	−0.1	−0.4
Middle Slope	6	1.36	179	+0.6	+0.3
Southern Slope*	7	0.95	90	−0.1	−0.3
Southern Plateau*	12	1.48	137	+0.4	+0.3
Middle Plateau*	10	1.10	92	−0.1	−0.3
Northern Plateau*	12	1.12	74	−0.4	−1.3
North Pacific	7	5.25	93	−0.4	−1.6
Middle Pacific	8	4.82	114	+0.6	+1.1
South Pacific	4	2.85	116	+0.4	+1.7

SNOWFALL.

More than the usual amount of snow occurred over the Appalachian Mountain region, New England, the Lake region, the Ohio and upper Mississippi valleys, and generally along the northern tier of States.

In the mountain regions of the west considerable snow occurred, especially over the more southerly districts, but the warm weather prevailing during the month prevented any decided increase in the depths accumulated at the end of January.

The greater part of the snow remaining on the ground in high elevations of the mountain districts, having fallen early in the season, is generally well-packed and probably above the average in water contents, thus assuring comparatively slow melting, and a moderate supply of water for irrigation until late in the season.

The distribution of the monthly fall and the amounts remaining on the ground at the end of the month are graphically shown on Charts VII and VIII.

HUMIDITY AND SUNSHINE.

From Texas eastward over the Gulf and Atlantic coast States there was a pronounced deficiency in the average relative humidity, also over the upper Lakes and portions of the central Plains and Rocky Mountain region.

Over most of the Missouri and upper Mississippi valleys, the northern tier of States from the upper Lakes westward and over the greater part of the Plateau and Pacific coast districts, there was an excess of relative humidity, the average in portions of New Mexico, Arizona, and California ranging from 10 to 30 per cent above the normal.

Cloudy, rainy weather was in excess of the average over most of the districts east of the Mississippi Valley, except Florida, and also over Arizona and portions of New Mexico. From the Missouri Valley westward, and over the Pacific slope there was generally more than the average amount of sunshine.

As a whole the month was unfavorable for outdoor occupations over most of the eastern districts, but over the great agricultural and stock-raising districts of the west conditions were favorable for the nearly uninterrupted pursuit of the usual outdoor occupations.

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Alpena, Mich	5	52	se.	Mount Weather, Va	27	52	nw.
Atlanta, Ga	1	56	nw.	Nantucket, Mass	1	58	se.
Do	15	50	nw.	Do	2	50	sw.
Block Island, R. I	1	58	se.	New Haven, Conn	1	54	se.
Do	2	60	sw.	New York, N. Y	1	54	w.
Do	4	52	nw.	Do	2	58	w.
Do	8	60	nw.	North Head, Wash	4	54	s.
Do	9	50	nw.	Do	5	72	se.
Do	15	50	s.	Do	6	50	s.
Buffalo, N. Y	1	76	sw.	Do	10	54	s.
Do	2	57	w.	Do	11	60	nw.
Do	6	54	w.	Do	15	56	se.
Canton, N. Y	1	56	w.	Do	16	54	se.
Chicago, Ill	5	54	w.	Do	26	60	sw.
Cleveland, Ohio	1	60	w.	Oklahoma, Okla	14	60	nw.
Do	6	51	sw.	Pittsburg, Pa	1	56	w.
Do	15	56	nw.	Do	6	54	w.
Detroit, Mich	5	58	sw.	Point Reyes Light, Cal.	2	60	se.
Do	6	54	sw.	Do	8	70	s.
Duluth, Minn	1	52	nw.	Do	9	73	n.
Do	16	54	nw.	Do	10	53	nw.
Eastport, Me	1	69	se.	Do	11	61	nw.
El Paso, Tex	13	51	w.	Do	12	62	nw.
Do	17	54	w.	Do	17	51	n.
Erie, Pa	1	54	w.	Do	18	50	nw.
Fort Worth, Tex	14	53	nw.	Do	26	54	nw.
Grand Haven, Mich	5	50	sw.	Do	28	54	sw.
Green Bay, Wis	18	52	ne.	Do	29	70	s.
Kansas City, Mo	5	53	nw.	Portland, Me	1	61	se.
Madison, Wis	19	54	ne.	Sioux City, Iowa	5	50	nw.
Milwaukee, Wis	5	50	se.	Southeast Farallon, Cal.	8	53	s.
Mount Tamalpais, Cal	2	52	se.	Do	29	54	sw.
Do	17	60	nw.	Syracuse, N. Y	6	62	s.
Do	29	58	sw.	Tatoosh Island, Wash	5	56	s.
Mount Weather, Va	1	58	nw.	Do	10	50	w.
Do	2	60	nw.	Do	26	56	s.
Do	3	53	nw.	Toledo, Ohio	1	53	sw.
Do	7	54	nw.	Do	5	55	sw.
Do	15	50	nw.	Do	6	52	sw.
Do	16	53	nw.				

6——4

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	74	— 1	Missouri Valley	75	0
Middle Atlantic	73	— 1	Northern Slope	73	+ 2
South Atlantic	74	— 2	Middle Slope	65	— 2
Florida Peninsula	75	— 5	Southern Slope	59	— 8
East Gulf	68	— 8	Southern Plateau	57	+10
West Gulf	70	— 4	Middle Plateau	69	— 1
Ohio Valley and Tennessee	73	— 1	Northern Plateau	78	· 0
Lower Lake	81	+ 1	North Pacific	82	+ 1
Upper Lake	80	— 2	Middle Pacific	81	+ 4
North Dakota	84	+ 4	South Pacific	74	+ 5
Upper Mississippi Valley	77	0			

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.4	— 0.1	Missouri Valley	5.6	+ 0.2
Middle Atlantic	5.7	+ 0.1	Northern Slope	5.6	+ 0.8
South Atlantic	4.9	— 0.4	Middle Slope	4.8	+ 0.4
Florida Peninsula	3.7	— 0.9	Southern Slope	5.0	+ 0.2
East Gulf	5.4	— 0.1	Southern Plateau	4.0	+ 1.0
West Gulf	5.0	— 0.8	Middle Plateau	5.0	+ 0.2
Ohio Valley and Tennessee	6.9	+ 0.7	Northern Plateau	6.4	— 0.3
Lower Lake	6.9	+ 0.1	North Pacific	7.2	+ 0.2
Upper Lake	7.3	+ 1.0	Middle Pacific	5.4	+ 0.6
North Dakota	6.1	+ 1.0	South Pacific	5.1	+ 1.0
Upper Mississippi Valley	5.8	+ 0.5			

CLIMATOLOGICAL SUMMARY.

By Mr. JAMES BERRY, Chief of the Climatological Division.

TEMPERATURE AND PRECIPITATION BY SECTIONS, FEBRUARY, 1908.

In the following table are given, for the various sections of the Climatological Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Section.	Temperature—in degrees Fahrenheit.								Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	44.4	− 2.0	Livingston	79	29	Riverton	8	2	6.30	+ 0.92	Evergreen	11.24	Highland Home	2.47
Arizona	47.9	− 0.3	Casagrande Parker	90 90	29 26	Grand Canyon	−15	14	2.31	+ 1.18	Pinal Ranch	6.90	Parker	0.00
Arkansas	44.2	+ 3.0	Camden Ozark	78 78	29 29	Pond	0	2	5.26	+ 1.35	Arkansas City	12.70	Fulton	1.92
California	46.8	− 1.0	Heber	92	27	Tamarack	−18	26	3.99	+ 0.59	Monumental	14.99	Needles	0.00
Colorado	27.4	+ 2.5	Lamar Holly	77 77	27 29	Rangely	−29	14	0.86	− 0.08	Durango	3.98	Canon City	0.00
Florida	56.4	− 3.6	Brooksville	87	13	3 stations	20	2,3	2.36	− 1.50	DeFuniak Springs	6.11	2 stations	0.70
Georgia	44.1	− 2.0	Waycross	82	13	Dahlonega Diamond	9 9	2 2	5.70	0.00	Greenbush	8.70	St. George	1.94
Hawaii	68.4†	......	Waialua Mill, Oahu	87	26	Humuula, Hawaii	30	19, 20	8.04‡	......	Waikaumalo, Hawaii	29.12	WaiopaeRanch, Maui	0.00
Idaho	29.8	+ 1.7	Emmett	69	26	3 stations	−42	1	1.02	− 0.40	Burke	4.94	Caldwell	0.04
Illinois	28.9	+ 2.4	4 stations	65	14, 29	Riley	−13	2	4.31	+ 1.94	Golconda	10.31	Ottawa	1.53
Indiana	29.0	+ 0.5	Marengo	66	13	Hammond South Bend	− 9 − 9	1 3	5.70	+ 2.84	Princeton	9.85	Salamonia	1.54
Iowa	24.3	+ 5.1	Keokuk	59	12	Decorah Thurman	−16 −16	2 2	1.69	+ 0.63	Olin	3.95	Clear Lake	0.23
Kansas	36.5	+ 6.7	Eldorado	79	23	Norton	−11	1	1.90	+ 0.91	Columbus	6.19	Lindsborg	0.45
Kentucky	35.6	+ 1.5	Catlettsburg	73	11	Scott Williamstown	2 2	2 2	5.56	+ 2.19	Blandville	8.32	Williamsburg	1.81
Louisiana	52.7	+ 0.9	Franklin	83	13	Minden	18	2, 3	5.86	+ 0.69	Ferriday	11.31	Lakeside	1.27
Maryland and Delaware	29.6	− 1.3	Millsboro, Del Salisbury, Md	68 68	15 15	Taneytown, Md	−15	9	4.18	+ 0.66	Emmittsburg, Md	7.02	Salisbury, Md	1.37
Michigan	18.9	− 0.1	Clinton	56	11	Omer	−27	9	3.44	+ 1.67	Pontiac	6.93	Croton	0.80
Minnesota	17.9	+ 6.8	St. Cloud	55	13	Detroit	−36	19	1.11	+ 0.40	Redwing	2.30	Faribault	0.29
Mississippi	47.3	− 0.2	Natchez	77	29	Okolona	13	2	7.95	+ 2.71	Natchez	11.41	Pecan	3.94
Missouri	35.6	+ 4.9	4 stations	78	29	Unionville	− 7	2	4.32	+ 2.01	New Madrid	9.35	Grant City	0.73
Montana	25.1	+ 4.1	Graham	68	27	Bowen	−55	1	0.87	+ 0.09	Snowshoe	6.21	Busby	T.
Nebraska	28.7	+ 5.1	Bridgeport	76	27	Fort Robinson	−24	1	1.06	+ 0.34	Blair	3.32	7 stations	T.
Nevada	34.6	+ 1.6	Leetville	79	27	Potts	−10	14	1.07	− 0.22	Hamilton	5.20	Mill City	0.01
New England*	20.7	− 2.6	Boston, Mass	60	15	Van Buren, Me	−38	5	4.81	+ 0.52	Waterbury, Conn	6.86	Bloomfield, Vt	2.00
New Jersey	28.1	− 1.5	Browns Mills	65	15	Layton	−17	10	4.79	+ 0.92	Charlotteburg	6.44	Cape May	2.85
New Mexico	37.7	+ 0.3	Monument Roswell	80 80	29 29	Tres Piedras	−12	19	0.93	+ 0.18	Frisco	2.92	3 stations	0.00
New York	18.8	− 2.8	3 stations	60	14–16	Indian Lake Keepewa	−42 −42	5 5	3.78	+ 1.02	Lake George (1)	7.40	Hemlock Lake	0.72
North Carolina	38.6	− 2.4	Ramseur	75	15	Mount Airy	− 4	3	4.76	+ 0.17	Hendersonville	8.19	Hatteras	2.60
North Dakota	13.8	+ 7.7	Chilcot	62	23	Mayville	−34	1	1.07	+ 0.51	Langdon	4.85	Flasher	T.
Ohio	27.7	+ 1.2	Thurman	66	12	Rome	−22	9	4.10	+ 1.51	North Lewisburg	6.45	New Berlin	1.93
Oklahoma	42.3	+ 5.9	Chandler Eldorado	90 90	28 28	Hurley	− 2	1	2.66	+ 1.92	Tulsa	5.41	Erick	0.25
Oregon	38.8	+ 1.2	Bay City Umatilla	78 78	22 26	Wallowa	−13	1	3.35	− 1.87	Glenora	12.62	2 stations	T.
Pennsylvania	24.8	− 2.4	Aleppo	64	12	Lawrenceville	−29	9	4.65	+ 1.64	Mauch Chunk	8.15	Lawrenceville	2.51
Porto Rico	73.0	......	Yauco	91	27	Aibonito Maricao	50 50	26 27, 28	4.22	......	Isolina	9.09	Santa Isabel	0.35
South Carolina	43.6	− 1.5	Blackville	81	29	Camden	12	3	5.28	+ 0.66	Effingham	9.06	Bennettsville	2.98
South Dakota	21.3	+ 5.6	Hermosa	71	26	Bowdle	−29	1	1.08	+ 0.64	Milbank	4.04	2 stations	0.10
Tennessee	39.6	+ 0.2	Sevierville	75	14	Mountain City	− 3	3	4.87	+ 0.02	Center Point	7.73	Birds Bridge	2.13
Texas	50.8	+ 1.5	Fort McIntosh Graham	90 90	24 29	Plemons	− 2	1	2.65	+ 1.04	Houston	9.01	4 stations	0.00
Utah	31.2	+ 2.0	Milford	80	28	Woodruff	−34	1	1.16	− 0.30	Ibapah	3.76	Tropic	0.23
Virginia	32.4	− 2.8	Doswell	71	15	Dale Enterprise	− 5	3, 9	3.79	+ 0.35	Speers Ferry	6.44	Riverton	2.14
Washington	36.7	+ 0.5	Mottingers Ranch	67	26	Cusick	−28	2	3.91	− 0.13	Forks	21.05	Wahluke	0.01
West Virginia	30.9	+ 0.1	Logan	72	12	Green Sulphur Sp'gs.	−10	3	3.72	+ 0.10	Terra Alta	6.26	Green Sulphur Sp'gs.	1.77
Wisconsin	20.5	+ 5.2	Whitehall	55	24, 25	Osceola	−29	2	1.65	+ 0.52	Sturgeon Bay	3.53	3 stations	0.82
Wyoming	24.1	+ 2.9	Luther	77	27	Norris, Y. N. P	−51	1	0.53	− 0.39	Lake, Y. N. P	3.63	Lusk	0.00

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. † 51 stations, with an average elevation of 737 feet. ‡ 146 stations.

DESCRIPTION OF TABLES AND CHARTS.

By Mr. P. C. DAY, Assistant Chief, Division of Meteorological Records.

For description of tables and charts see page 8 of REVIEW for January, 1908.

TABLE I.—*Climatological data for U. S. Weather Bureau stations, February, 1908.*

Stations.	Elevation of instruments. Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Pressure, in inches. Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Temperature of the air, in degrees Fahrenheit. Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches. Total.	Departure from normal.	Days with .01, or more.	Wind. Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Direction.	Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
New England.							22.9	− 3.1										74	3.92	+ 0.5										5.4	
Eastport	76	69	85	29.90	29.99	+ .01	20.6	− 0.8	48	15	30	−10	5	12	44	18	14	74	3.71	− 0.1	10	9,653	w.	69	se.	1	6	10	13	6.8	17.8
Greenville				28.77	29.99		11.4		48	15		−19	5						4.93												
Portland, Me.	103	81	117	29.90	30.03	+ .01	21.4	− 2.4	48	15	29	− 5	5	18	33	19	13	72	3.72	− 0.1	10	7,150	nw.	61	se.	1	13	6	10	5.2	23.5
Concord	288	70	79	29.73	30.06	+ .02	19.8	− 3.8	55	15	29	−11	5	10	40				3.31	− 0.1	11	4,574	nw.	28	sw.	2	20	1	8	3.4	27.8
Burlington	404	12	47	29.61	30.09	+ .06	14.3	− 6.6	52	15	23	−27	5	5	32				2.27	+ 0.8	13	8,151	s.	40	s.	1	6	11	12	6.1	18.9
Northfield	876	16	70	29.06	30.06	+ .02	11.8	− 5.4	50	15	23	−35	5	1	40	10	7	82	4.44	− 2.1	14	5,951	s.	34	sw.	15	5	12	12	6.4	41.3
Boston	125	115	188	29.90	30.04	.00	26.8	− 1.2	60	15	35	− 2	5	19	33	23	16	66	2.96	− 0.6	10	8,992	nw.	43	se.	1	11	9	9	5.1	9.3
Nantucket	12	14	90	30.02	30.03	− .01	28.4	− 4.2	50	15	35	3	9	22	34	26	23	82	3.71	+ 0.5	12	12,605	w.	58	se.	1	8	7	14	6.7	3.6
Block Island	26	11	46	30.02	30.05	− .01	28.6	− 2.4	53	15	36	4	9	22	32	26	20	70	3.53	− 0.9	9	15,950	nw.	60	sw.	2	12	8	9	4.8	2.8
Narragansett		9					26.8	− 1.5	52	15	36	− 2	5	18	38				3.81		11		nw.				19	2	8		8.0
Providence	160	57	67	29.88	30.06	+ .01	26.0	− 3.0	57	15	35	− 2	5	17	35	22	16	68	4.00	+ 0.4	11	6,481	w.	37	w.	2	10	11	8	5.0	9.8
Hartford	159	122	132	29.88	30.07	+ .01	24.2	− 3.0	56	15	33	− 6	5	16	34	21	15	71	4.98	+ 1.3	12	5,624	nw.	48	s.	15	11	8	10	5.2	18.6
New Haven	106	116	155	29.96	30.08	+ .01	26.0	− 2.3	53	15	34	− 3	5	18	32	23	16	68	6.44	+ 2.6	10	7,989	nw.	54	se.	1	11	9	9	4.9	20.0
Mid. Atlantic States.							29.4	− 3.7										73	3.55	+ 0.4										5.7	
Albany	97	102	115	29.98	30.10	+ .03	19.6	− 4.0	54	15	28	−15	5	11	37	18	14	81	2.77	+ 0.2	11	4,071	s.	22	se.	1	10	9	10	5.2	20.6
Binghamton	871	78	90	29.10	30.08	.00	18.8	− 5.9	56	15	28	−21	5	9	45				3.09	+ 1.1	14	5,800	nw.	35	se.	1	4	7	18	7.4	19.1
New York	314	108	350	29.73	30.08	.00	28.1	− 2.6	56	15	35	1	5	21	30	25	19	69	5.36	+ 1.5	11	11,035	nw.	58	w.	2	11	10	8	4.9	13.7
Harrisburg	374	94	104	29.70	30.12	+ .03	25.6	− 4.3	54	15	32	1	5	19	28	23	18	72	5.01	+ 2.2	10	6,631	w.	42	w.	2	10	9	10	5.5	26.4
Philadelphia	117	116	184	29.99	30.12	+ .02	31.2	− 1.6	63	15	38	5	5	24	27	28	23	73	3.21	− 0.3	10	8,467	nw.	42	se.	15	9	13	7	5.1	10.5
Scranton	805	111	119	29.18	30.09	+ .01	23.1	− 3.8	58	15	31	− 7	5	15	33	20	15	71	4.40	+ 1.6	16	6,231	sw.	34	s.	15	5	6	18	7.0	16.8
Atlantic City	52	37	45	30.06	30.12	+ .01	30.1	− 2.9	49	15	37	6	5	23	28	27	22	72	2.94	− 0.4	10	6,867	nw.	43	se.	1	8	9	12	6.1	2.8
Cape May	17	48	52	30.13	30.15	+ .04	31.2	− 2.9	50	15	37	6	5	25	32	29			2.85	− 0.5	11	8,080	nw.	48	s.	15	7	15	7	5.5	3.4
Baltimore	123	100	113	29.98	30.12	+ .01	31.2	− 3.4	66	15	38	9	9	24	28	28	21	67	4.71	+ 1.1	10	5,691	nw.	32	sw.	1	9	10	10	5.5	12.1
Washington	112	59	76	30.00	30.14	+ .03	30.8	− 3.7	67	15	38	6	9	24	30	27	19	64	3.98	+ 0.4	9	6,257	nw.	36	nw.	2	11	8	10	5.2	13.6
Cape Henry	18	11	58	30.12	30.14	+ .03	38.0	− 3.2	70	15	45	17	3	31	28				2.19	+ 1.7	10	10,403	n.	46	w.	2	8	14	7	5.4	0.3
Lynchburg	681	83	88	29.38	30.15	+ .04	34.1	− 4.1	63	15	42	12	9	26	27	30	25	72	2.85	− 0.8	10	3,766	nw.	27	nw.	20	11	10	8	5.3	12.1
Mount Weather	1,725	10	54	28.18	30.11	.00	24.6	− 4.5	58	15	31	4	9	18	30	22	19	81	3.85	+ 0.6	11	13,311	nw.	60	nw.	2	10	9	10	5.9	16.8
Norfolk	91	102	111	30.04	30.14	+ .03	39.0	− 2.8	68	15	46	19	3	32	27	34	28	69	2.79	− 1.1	9	7,524	n.	45	sw.	1	9	7	13	5.8	0.3
Richmond	144	145	153	29.97	30.14	+ .03	36.6	− 3.3	68	15	45	15	9	28	27				3.92	+ 0.7	10	6,368	w.	49	s.	15	9	11	9	5.6	7.8
Wytheville	2,293	40	47	27.66	30.15	+ .03	29.4	− 5.7	61	14	37	3	2	22	34	26	23	82	2.56	− 1.7	17	5,975	w.	36	w.	1	7	8	14	6.2	16.7
S. Atlantic States.							44.0	− 3.9										74	3.58	− 0.6										4.9	
Asheville	2,255	53	75	27.72	30.17	+ .04	33.4	− 5.1	61	14	42	5	3	25	33	30	28	84	3.10	− 1.7	15	7,995	nw.	38	nw.	1	10	5	14	5.5	14.8
Charlotte	773	68	76	29.29	30.15	+ .03	38.4	− 5.7	63	14	46	17	3	31	27	33	25	65	3.75	− 0.8	13	5,734	ne.	40	sw.	15	8	9	12	6.0	2.1
Hatteras	11	12	47	30.12	30.13	+ .02	43.8	− 2.8	62	15	50	25	2	38	24	41	38	83	2.60	− 2.0	9	12,073	ne.	48	nw.	2	12	8	9	4.9	T.
Manteo							42.3		65	14	50	20	3	35					2.40	− 2.0	8		ne.				16	7	6		
Raleigh	376	71	79	29.73	30.15	+ .04	39.2	− 4.1	66	14	48	16	3	31	27	34	28	68	3.66	− 0.8	10	5,458	w.	32	s.	15	11	11	7	5.0	0.1
Wilmington	78	81	91	30.07	30.16	+ .04	45.6	− 2.1	67	15	54	21	3	37	28	41	37	78	5.68	+ 2.2	10	7,311	w.	41	sw.	15	12	9	8	5.0	
Charleston	48	14	92	30.10	30.15	+ .03	48.5	− 3.2	68	13	56	26	3	41	25	44	41	79	3.15	− 0.4	8	9,972	nw.	46	sw.	15	14	8	7	4.1	
Columbia, S. C.	351	41	57	29.76	30.15	+ .04	43.4	− 4.4	69	29	53	20	3	34	32	38	31	68	3.74	− 1.0	12	6,455	w.	40	w.	15	10	8	11	5.7	
Augusta	180	89	97	29.96	30.16	+ .04	44.6	− 4.4	74	14	54	21	3	35	35	39	33	69	3.75	− 0.8	13	6,325	w.	36	w.	15	14	6	9	4.4	
Savannah	65	81	89	30.09	30.16	+ .04	49.4	− 3.1	71	13	58	25	3	41	28	43	36	66	4.62	+ 1.2	10	7,284	nw.	34	w.	15	14	5	10	4.5	
Jacksonville	43	101	129	30.12	30.16	+ .04	53.2	− 3.7	76	13	62	28	3	45	26	48	45	81	2.98	− 0.6	10	7,773	nw.	38	sw.	15	17	5	7	4.0	
Florida Peninsula.							62.4	− 3.6										75	1.37	− 1.1										3.7	
Jupiter	28	10	48	30.10	30.13	+ .05	62.0	− 4.3	82	1	70	40	21	54	26	57	54	79	1.96	− 1.2	11	9,415	nw.	35	e.	9	10	14	5	4.6	
Key West	22	10	53	30.10	30.12	+ .05	66.6	− 4.2	80	14	72	51	21	61	17	61	57	76	1.73	0.0	9	8,056	ne.	40	nw.	15	13	14	2	3.9	
Sand Key	25	41	71	30.08	30.11	+ .04	67.0	......	81	6	71	54	21	63	13	....	....	....	0.70	− 1.0	10	12,302	ne.	42	w.	15	16	8	5	4.0	
Tampa	35	79	96	30.13	30.17	+ .07	58.7	− 2.2	80	11	67	33	3	50	29	51	46	70	1.10	− 2.2	7	6,830	ne.	32	w.	27	20	7	2	2.2	
East Gulf States.							47.6	− 3.3										68	4.98	+ 0.1										5.4	
Atlanta	1,174	190	216	28.89	30.16	+ .04	40.2	− 5.0	67	29	48	16	2	33	32	34	27	66	4.40	− 0.4	11	11,253	nw.	56	nw.	1	13	5	11	4.8	T.
Macon	370	55	66	29.77	30.18	+ .06	45.1	− 3.8	73	14	55	22	3	36	34	....	....	....	3.77	− 0.9	11	4,643	nw.	23	w.	1	12	6	11	5.2	
Thomasville	273	8	58	29.87	30.18	+ .06	50.0	− 5.0	79	18	62	23	3	38	37	43	38	72	4.66	0.0	11	5,305	nw.	38	sw.	15	16	6	7	4.0	
Pensacola	56	79	96	30.12	30.18	+ .07	51.6	− 3.9	70	14	59	29	3	44	26	....	....	....	3.96	− 0.7	9	8,335	nw.	44	se.	9	11	4	14	5.4	
Anniston	741	9	58	29.38	30.19	+ .07	41.8	− 4.0	71	29	51	16	3	32	35	....	....	....	4.39	− 0.4	8	6,281	nw.	37	se.	10	8	4	17	6.7	T.
Birmingham	700	11	48	29.39	30.18	+ .06	43.9	− 4.4	69	29	52	17	2	35	32	37	31	66	4.90	0.0	9	6,812	nw.	43	se.	25	10	6	13	5.8	T.
Mobile	57	98	106	30.11	30.17	+ .06	52.1	− 1.1	68	23	60	30	2	44	29	46	41	72	4.35	− 1.2	8	5,835	nw.	36	se.	9	11	9	9	5.1	
Montgomery	223	100	112	29.93	30.19	+ .07	46.6	− 4.7	75	13	56	23	3	38	28	40	33	65	3.55	− 2.2	8	6,173	nw.	31	sw.	14	8	9	12	6.1	
Meridian	375	84	93	29.75	30.16	+ .05	46.2	− 2.9	72	29	56	20	3	37	36	41	35	69	8.29	+ 3.2	6	5,827	nw.	30	w.	14	12	3	14	5.7	
Vicksburg	247	62	74	29.87	30.16	+ .06	50.2	− 0.7	74	29	59	24	2	42	28	44	38	66	8.39	+ 3.6	10	6,455	se.	38	nw.	15	10	7	12	5.9	T.
New Orleans	51	88	121	30.10	30.15	+ .06	55.4	− 0.9	78	18	63	33	2	48	26	49	43	70	4.14	− 0.4	6	7,680	se.	40	se.	18	12	7	10	4.9	
West Gulf States.							50.3	+ 1.1										70	5.27	+ 0.5										5.0	
Shreveport	249	77	84	29.87	30.15	+ .06	49.8	− 0.2	75	28	58	23	2	41	31	43	37	66	4.78	+ 1.1	10	6,345	se.	38	w.	14	14	4	11	5.1	
Bentonville	1,303	11	44	28.68	30.08	− .02	40.6	+ 2.1	75	29	51	7	2	30	36	....	....	....	3.98	+ 1.4	10	5,891	nw.	27	s.	5	9	9	11	5.7	8.4
Fort Smith	457	79	94	29.61	30.10	.00	44.2	+ 2.4	77	29	54	14	1	35	34	39	33	70	2.48	− 0.3	10	7,732	e.	46	nw.	18	11	9	9	4.9	T.
Little Rock	357	139	147	29.74	30.13	+ .02	46.0	+ 1.9	72	28	54	18	2	38	33	40	34	68	3.32	− 1.0	11	8,387	e.	45	sw.	14	11	8	10	5.0	T.
Corpus Christi	20	48	53	30.10	30.12	+ .07	59.7	+ 2.0	79	18	67	38	2	52	29	53	48	72	1.09	− 1.0	7	7,795	se.	37	se.	28	9	10	10	5.8	
Fort Worth	670	106	114	29.40	30.13	+ .06	49.7	+ 1.6	85	29	60	20	1	40	33	....	....	....	2.45	+ 1.1	7	8,786	s.	53	nw.	14	16	4	9	4.5	
Galveston	54	106	112	30.10	30.16	+ .09	55.0	− 0.6	73	18	60	32	2	50	23	52	50	86	3.35	+ 0.1	9	9,507	se.	46	nw.	14	11	9	9	4.9	
Palestine	510	73	79	29.58	30.12	+ .04	50.8	− 0.1	77	29	60	28	2	42	30	45	38	68	4.45	+ 0.9	10	7,046	s.	42	w.	14	11	5	13	5.5	
San Antonio	701	80	91	29.38	30.12	+ .06	55.3	+ 0.9	80	28	66	27	20	45	34	47	40	61	2.42	+ 0.6	7	5,562	se.	38	nw.	14	15	5	9	4.8	
Taylor	583	55	63	29.51	30.14	+ .08	52.0	+ 0.7	78	29	62	24	20	42	32	....	....	....	4.41	+ 1.7	9	6,986	nw.	36	nw.	14	15	4	10	4.5	
Ohio Val. and Tenn.							34.6	− 1.6										75	4.31	+ 0.6										6.9	
Chattanooga	762	106	112	29.34	30.18	+ .05	40.8	− 2.9	67	14	49	13	2	33	28	36	29	68	4.90	− 0.2	16	5,614	nw.	36	se.	25	8	7	14	6.1	0.5
Knoxville	1,004	93	100	29.06	30.14	+ .02	38.4	− 2.4	70	14	46	12	2	30	30	33	27	68	2.87	− 2.2	11	4,435	w.	31	w.	1	4	8	17	7.2	T.
Memphis	399	76	97	29.72	30.15	+ .04	44.4	+ 1.1	70	29	52	16	2	37	34	39	34	70	5.36	+ 0.9	12	8,497	nw.	48	w.	14	12	5	12	5.6	T
Nashville	546	79	91	29.56	30.15	+ .03	40.6	− 0.5	66	14	48	14	2	33	32	36	29	68	4.15	− 0.3	12	6,237	w.	42	se.	5	7	4	18	6.9	T.
Lexington	989	75	102	29.02	30.13	+ .02	33.2	− 2.4	63	14	40	5	2	26	36	....	....	....	4.81	+ 1.5	16	10,164	w.	49	sw.	1	8	3	18	7.0	6.0
Louisville	525	111	132	29.52	30.13	+ .02	35.4	− 1.2	65	14	42	7	2	28	32	31	27	73	5.68	+ 1.8	15	7,885	w.	42	w.	1	6	6	17	6.7	4.7
Evansville	431	72	82	29.62	30.11	.00	35.8	0.0	63	14	42	8	2	30	28	....	....	....	6.26	+ 3.1	16	6,816	w.	38	w.	1	7	8	14	6.6	7.9
Indianapolis	822	154	164	29.17	30.09	− .01	29.4	− 1.3	54	14	36	0	2	23	33	26	23	80	4.46	+ 1.3	13	9,379	w.	44	sw.	1	8	7	19	7.9	11.1
Cincinnati	628	152	160	29.41	30.11	+ .01	33.1	− 1.3	62	14	41	3	2	26	34	29	24	70	4.50	+ 1.2	12	6,989	w.	40	w.	1	7	5	17	7.1	3.2
Columbus	824	173	224	29.18	30.09	.00	29.6	− 1.4	58	14	37	1	2	22	33	27	22	76	3.66	+ 0.5	14	10,538	nw.	46	w.	6	6	8	15	7.0	4.3
Pittsburg	842	336	352	29.15	30.09	.00	28.0	− 3.8	60	15	36	− 1	9	20	32	25	20	76	2.89	+ 0.1	17	9,484	w.	56	w.	1	4	10	15	6.9	13.5
Parkersburg	638	77	84	29.44	30.11	+ .01	32.2	− 1.7	63	12	40	7	2	24	32	29	26	79	3.29	− 0.1	11	6,075	nw.	42	nw.	15	5	9	15	7.1	4.3
Elkins	1,940	41	50	27.98	30.14	+ .04	28.3	− 3.2	64	13	37	1	9	20	40	25	21	78	3.22	− 0.1	20	4,174	w.	30	w.	1	6	5	18	7.3	14.3
Lower Lake Region.							21.2	− 3.3										81	3.90	+ 1.4										6.9	
Buffalo	767	178	206	29.18	30.05	− .01	21.4	− 2.6	50	14	28	− 8	5	14	36	19	16	82	5.18	+ 2.2	23	12,341	w.	76	sw.	1	3	11	15	7.2	36.1
Canton	448	10	71	29.55	30.06	......	11.6	− 6.4	43	13	21	−40	5	2	45	....	....	....	3.94	+ 1.3	14	8,033	w.	56	sw.	1	7	8	14	6.6	27.5
Oswego	335	76	91	29.67	30.05	− .01	18.8	− 5.1	52	15	26	−18	5	11	35	18	16	86	4.70	+ 2.0	20	9,765	s.	44	w.	2	4	3	22	7.8	29.0
Rochester	523	81	102	29.46	30.06	.00	21.2	− 2.7	52	15	28	− 5	5	15	28	19	15	78	2.44	− 0.5	18	7,584	w.	44	sw.	1	2	9	18	7.6	19.8
Syracuse	597	97	113	29.38	30.06	− .01	19.2	− 4.6	56	15	27	−17	5	11	39	....	....	....	2.23	+ 0.4	20	9,674	s.	62	s.	6	4	10	15	7.1	16.3
Erie	713	92	102	29.25	30.06	− .01	23.4	− 2.7	56	15	30	− 4	9	16	35	21	17	78	2.65	− 0.3	16	9,864	w.	54	w.	1	9	7	13	6.0	17.2
Cleveland	762	190	201	29.21	30.04	− .03	25.0	− 1.8	53	13	32	0	9	18	29	23	18	74	4.66	+ 2.0	22	12,472	se.	60	w.	1	5	7	17	7.1	30.5
Sandusky	629	62	70	29.35	30.06	− .01	25.4	− 1.7	54	14	32	4	2	19	26	....	....	....	3.70	+ 1.2	15	7,467	w.	33	nw.	15	7	5	17	6.7	15.8
Toledo	628	207	246	29.36	30.07	.00	24.4	− 2.4	53	13	31	1	2	18	25	23	19	82	4.55	+ 2.5	15	12,184	sw.	55	sw.	5	8	6	15	6.3	22.2
Detroit	730	218	258	29.23	30.06	.00	21.8	− 3.2	49	13	28	− 2	9	16	28	20	18	87	4.95	+ 2.7	13	11,999	w.	58	sw.	5	6	6	17	6.8	38.4
Upper Lake Region.							19.4	+ 0.4										80	2.56	+ 0.8										7.3	
Alpena	609	13	92	29.35	30.05	+ .02	17.0	− 0.8	42	13	26	−13	9	8	33	15	12	82	1.84	0.0	16	8,937	nw.	52	se.	5	8	11	15	7.3	25.8

TABLE I.—*Climatological data for U. S. Weather Bureau stations, February, 1908*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.												Precipitation, in inches.			Wind.									
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Total.	Departure from normal.	Days with .01, or more.	Total movement miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
Up. Lake Reg—Cont.																															
Escanaba	612	40	82	29.37	30.07	+.01	17.8	+2.5	44	13	25	-5	2	11	31	16	12	76	2.38	+1.0	12	8,503	n.	37	n.	26	1	12	16	7.4	23.7
Grand Haven	632	54	92	29.33	30.05	.00	22.6	-1.6	47	11	29	1	8	16	27	21	18	80	2.84	+0.8	16	11,221	nw.	50	sw.	5	2	6	21	8.2	20.9
Grand Rapids	707	121	162	29.25	30.05	.00	22.4	-3.1	50	11	29	-1	9	16	29	20	17	83	2.69	+0.7	15	9,921	nw.	44	sw.	5	3	4	22	8.0	17.6
Houghton	668	66	74	29.30	30.06	+.01	17.2	+1.2	47	11	25	-6	24	10	48	....	....	...	1.93	+0.2	18	5,790	nw.	33	n.	26	0	9	20	8.4	21.9
Marquette	734	77	116	29.24	30.07	+.02	18.4	+2.5	44	11	24	3	2	13	27	17	13	78	3.63	+1.8	14	9,518	nw.	46	nw.	26	0	13	16	7.9	34.9
Port Huron	638	70	120	29.34	30.05	.00	20.0	-2.0	45	13	27	-6	9	13	37	18	14	80	3.26	+1.0	10	9,821	nw.	46	w.	6	10	5	14	6.3	22.1
Sault Sainte Marie	614	40	61	29.34	30.08	+.05	12.0	-1.4	41	13	20	-21	8	4	35	10	7	83	2.64	+1.2	13	6,681	nw.	37	e.	5	4	5	20	7.7	24.7
Chicago	823	140	310	29.15	30.08	.00	26.7	+1.3	50	12	32	-2	2	21	29	24	21	79	3.72	+1.5	11	12,860	nw.	54	w.	5	7	5	17	6.9	19.8
Milwaukee	681	122	139	29.31	30.08	+.02	23.8	+1.9	45	12	30	-7	2	18	29	22	19	81	2.87	+0.9	10	9,899	nw.	50	se.	5	7	7	15	6.2	25.3
Green Bay	617	49	86	29.36	30.05	-.01	19.0	+1.8	44	12	27	-11	2	11	30	17	13	77	1.75	+0.1	9	8,806	nw.	52	ne.	18	2	7	20	7.7	16.9
Duluth	1,138	11	47	28.79	30.07	-.01	16.2	+2.6	41	24	24	-12	2	9	29	14	10	78	1.14	+0.1	7	10,063	nw.	54	nw.	16	10	6	13	5.8	8.8
North Dakota.							14.0	+7.0										84	1.46	+0.9										6.1	
Moorhead	940	8	57	29.08	30.14	+.03	14.6	+7.6	40	24	23	-20	1	6	33	14	12	90	2.18	+1.4	8	6,564	nw.	28	nw.	5	7	10	12	6.0	15.8
Bismarck	1,674	8	57	28.27	30.14	+.02	16.8	+8.5	50	23	26	-21	1	7	35	14	10	75	1.07	+0.6	8	8,332	nw.	40	nw.	24	7	12	10	6.3	10.2
Devils Lake	1,482	11	44	28.45	30.11	.00	10.1	+5.6	42	24	20	-26	1	0	33	9	6	83	2.20	+1.6	9	8,629	w.	36	nw.	2	12	7	10	5.2	18.2
Williston	1,875	14	56	28.03	30.10	-.01	14.4	+6.5	44	23	24	-23	1	5	37	13	11	87	0.39	-0.1	6	6,848	nw.	36	nw.	24	5	9	15	6.9	3.9
Upper Miss. Valley.							27.0	+2.4										77	2.72	+0.9										5.8	
Minneapolis	......	102	208	......	......	......	21.4	......	52	24	29	-8	1	14	33	....	....	...	0.98	+0.2	7	10,139	w.	39	nw.	25	10	8	11	5.4	10.6
St. Paul	837	171	179	29.14	30.09	.00	21.4	+6.4	51	24	29	-10	2	14	35	19	13	70	0.87	0.0	11	9,158	nw.	37	nw.	25	5	16	8	6.1	5.7
La Crosse	714	71	87	29.28	30.09	+.01	22.6	+4.2	50	24	31	-11	2	15	39	....	....	...	1.71	+0.6	9	4,989	nw.	22	s.	12	7	4	18	6.7	11.1
Madison	974	70	78	28.97	30.08	+.01	21.4	+1.8	46	12	28	-10	2	14	31	19	15	79	1.79	+0.2	9	9,481	nw.	54	ne.	19	8	3	18	6.5	11.4
Charles City	1,015	3	49	28.97	30.10	.00	21.5	+6.4	48	24	30	-9	2	13	38	20	18	87	1.44	+0.4	8	6,805	nw.	28	sw.	24	6	7	16	6.9	12.5
Davenport	606	71	79	29.40	30.10	.00	26.1	+2.3	55	12	33	-4	2	19	31	23	20	80	2.37	+0.8	10	7,795	nw.	33	nw.	5	13	4	12	5.4	13.9
Des Moines	861	84	101	29.14	30.09	-.02	26.1	+2.0	48	12	33	-5	2	19	39	24	20	77	1.51	+0.4	7	7,591	nw.	30	n.	18	9	8	12	6.1	10.4
Dubuque	698	100	117	29.32	30.11	+.02	24.0	+2.4	52	12	32	-8	2	16	37	22	18	79	1.87	+0.4	8	6,341	nw.	28	n.	19	11	5	13	5.6	13.6
Keokuk	614	64	77	29.40	30.11	.00	28.9	+2.3	59	12	36	-2	2	22	30	25	22	79	2.86	+1.2	9	7,630	nw.	38	w.	5	15	5	9	4.4	13.5
Cairo	356	87	93	29.73	30.13	+.01	39.0	+1.4	65	14	46	10	2	32	28	35	29	71	6.98	+3.5	15	8,249	w.	43	se.	18	7	8	14	6.6	1.2
La Salle	536	56	64	29.50	30.10	+.02	25.8	+0.8	52	12	32	-4	2	19	28	....	....	....	2.76	+0.2	10	8,545	w.	34	w.	5	9	8	12	5.8	14.8
Peoria	609	11	45	29.41	30.10	.00	27.0	+1.1	55	12	34	-3	2	20	35	24	20	78	3.98	+1.2	9	8,997	nw.	42	w.	5	13	6	10	4.7	12.3
Springfield, Ill	644	10	92	29.38	30.09	-.01	29.7	+0.6	52	12	36	2	2	23	28	26	22	75	4.28	+1.4	10	8,814	nw.	33	w.	1	11	5	13	5.7	17.2
Hannibal	534	75	109	29.49	30.09	-.02	30.2	+1.1	61	12	38	-1	2	23	30	....	....	....	4.05	+2.4	12	9,102	nw.	39	sw.	12	11	6	12	5.3	11.9
St. Louis	567	208	217	29.45	30.08	-.03	34.3	+4.9	62	29	42	6	2	27	30	31	27	75	3.39	+0.5	13	9,315	nw.	44	w.	5	12	5	12	5.7	4.4
Missouri Valley.							39.3	+3.7										75	2.13	+1.0										5.6	
Columbia, Mo	784	11	84	29.24	30.10	-.01	33.1	+3.0	71	29	42	2	2	24	32	....	....	....	4.06	+1.8	13	8,488	nw.	40	sw.	5	12	6	11	5.4	14.9
Kansas City	963	116	181	29.03	30.10	-.01	34.4	+4.5	59	7	43	4	1	26	34	29	24	70	2.77	+1.1	10	11,254	nw.	53	nw.	5	10	11	8	4.8	4.6
Springfield, Mo	1,324	98	104	28.64	30.08	-.03	37.4	+3.8	76	29	46	4	2	28	34	33	29	79	4.92	+2.5	10	9,584	se.	43	sw.	5	13	7	9	5.1	6.7
Iola	984	11	50	29.02	30.10	.00	38.2	+5.2	71	28	49	5	2	28	36	....	....	....	2.93	+1.8	10	6,976	nw.	38	ne.	14	5	16	8	5.8	1.2
Topeka	....	85	89	......	......	......	35.2	+5.2	63	7	45	3	1	26	38	....	....	....	2.40	+1.0	11	7,427	nw.	37	nw.	5	10	11	8	4.9	1.8
Lincoln	1,189	11	84	28.79	30.10	.00	28.6	+3.8	56	22	37	-4	1	20	40	25	21	74	2.13	+1.4	9	8,386	se.	44	n.	18	9	10	10	5.2	15.2
Omaha	1,105	115	121	28.88	30.11	.00	27.4	+3.7	49	22	34	-1	1	20	33	25	21	76	2.14	+1.4	11	7,879	nw.	44	n.	18	6	8	15	6.6	15.3
Valentine	2,598	47	54	27.29	30.11	+.02	25.8	+4.6	66	28	37	-12	1	14	46	22	17	74	0.40	-0.2	7	8,220	nw.	40	nw.	5	9	14	6	5.0	3.4
Sioux City	1,135	96	164	28.84	30.11	-.01	24.0	+4.2	53	24	31	-5	1	17	34	....	....	....	1.18	+0.6	9	10,216	nw.	50	nw.	5	9	8	12	5.8	6.7
Pierre	1,572	70	78	28.39	30.12	+.01	24.2	+7.3	60	23	33	-13	1	15	33	21	15	70	0.46	0.0	7	7,925	nw.	40	nw.	24	8	12	9	5.7	2.4
Huron	1,306	56	67	28.68	30.15	+.03	19.6	+6.7	53	24	23	-14	1	10	33	17	14	83	1.17	+0.7	8	8,009	se.	38	nw.	5	9	8	12	5.8	9.5
Yankton	1,233	49	57	28.74	30.12	.00	23.8	+5.6	54	24	32	-7	1	16	32	....	....	...	0.99	+0.4	5	6,899	nw.	36	nw.	5	6	6	17	6.7	6.7
Northern Slope.							24.9	+3.7										73	0.78	-0.1										5.6	
Havre	2,505	11	44	27.34	30.09	+.02	18.6	+3.6	55	23	30	-15	18	8	42	17	15	86	0.75	+0.3	5	5,682	sw.	32	sw.	14	11	13	5	5.0	7.5
Miles City	2,371	26	48	27.49	30.15	+.06	20.7	+3.9	56	23	32	-30	1	10	42	16	12	75	0.66	+0.1	6	3,742	ne.	28	nw.	24	8	9	12	5.9	5.8
Helena	4,110	8	56	25.78	30.10	-.01	28.0	+5.8	55	26	37	-14	1	19	30	23	17	63	0.29	-0.3	4	4,308	sw.	45	w.	25	6	8	15	6.5	5.1
Kalispell	2,962	8	34	26.94	30.10	+.02	26.2	+2.4	48	26	34	-13	1	18	32	24	21	82	0.81	-0.7	15	2,448	w.	19	sw.	27	5	6	18	7.2	4.6
Rapid City	3,234	46	50	......	......	......	......	......	....	....	....	....	....	....	....	....	....	....	......	......	....	......	......	....	......	....	....	....	....	....	....
Cheyenne	6,088	56	64	23.92	30.06	+.03	29.7	+3.4	64	27	42	-14	1	17	41	23	14	55	0.20	-0.4	7	7,380	nw.	42	nw.	4	10	14	5	4.5	1.8
Lander	5,372	26	36	24.59	30.13	+.05	22.8	+1.0	59	27	37	-21	1	8	41	19	15	74	1.52	+0.8	4	1,962	ne.	26	sw.	29	6	21	2	4.7	15.2
Sheridan	3,790	9	47	26.06	30.09	......	27.4	......	65	27	40	-20	1	14	41	23	18	73	0.32	......	7	4,221	nw.	44	nw.	27	9	13	7	5.0	7.5
Yellowstone Park	6,200	11	48	23.82	30.12	+.02	23.2	+3.6	48	23	33	-26	1	13	35	20	16	73	1.22	-0.7	10	5,130	sw.	26	sw.	26	8	6	15	6.2	18.4
North Platte	2,821	11	51	27.09	30.12	+.05	30.2	+5.6	68	28	42	-9	1	19	48	25	21	76	0.78	+0.4	5	5,764	n.	38	n.	24	13	4	12	5.4	4.9
Middle Slope.							37.6	+5.2										65	1.36	+0.6										4.8	
Denver	5,291	129	136	24.67	30.04	+.03	35.0	+3.9	71	27	48	-9	1	22	51	27	15	47	0.04	-0.5	2	5,028	s.	34	n.	24	11	17	1	4.0	1.1
Leadville	10,248	7	....	......	......	......	20.0	......	47	27	32	-7	1	8	43	....	....	....	0.58	......	7	......	n.	....	......	....	....	....	....	....	13.6
Pueblo	4,685	80	86	25.24	30.03	+.03	35.4	+3.6	70	27	50	0	1	21	55	28	18	56	0.69	+0.2	4	4,785	nw.	43	w.	29	18	9	2	3.4	5.2
Concordia	1,398	42	50	28.58	30.10	+.01	34.1	+5.3	64	7	43	1	1	25	41	30	26	77	1.03	+0.2	7	5,868	nw.	33	nw.	5	9	13	7	5.3	2.0
Dodge	2,509	44	54	27.40	30.06	.00	37.8	+6.7	74	4	50	-1	1	25	42	31	25	68	0.77	0.0	8	8,165	nw.	48	nw.	18	14	11	4	4.6	5.6
Wichita	1,358	78	86	28.63	30.10	+.02	39.3	+6.3	70	28	50	5	1	29	39	34	27	69	2.50	+1.4	8	7,786	nw.	41	n.	18	5	15	9	5.8	0.8
Oklahoma	1,214	10	47	28.76	30.07	.00	44.0	+5.5	79	29	54	10	1	34	34	38	32	71	3.14	+2.1	8	12,877	s.	60	nw.	14	13	4	12	5.4	0.5
Southern Slope.							46.8	+2.3										59	0.43	-0.7										5.0	
Abilene	1,738	45	54	28.26	30.10	+.05	49.6	+4.8	84	29	61	15	2	38	37	41	32	57	0.11	-1.0	3	7,368	s.	48	w.	14	9	11	9	5.3	
Amarillo	3,676	10	49	26.25	30.04	+.02	40.4	+3.2	77	28	53	4	1	27	43	32	25	65	0.72	-0.2	5	9,318	nw.	47	sw.	4	17	10	2	3.9	6.0
Del Rio	944	8	57	29.11	30.11	+.11	54.0	+0.4	79	26	66	24	2	42	38	....	....	...	0.60	-1.3	4	4,838	se.	44	w.	14	11	10	8	4.9	
Roswell	3,578	9	57	26.37	30.06	+.08	43.0	+0.9	80	29	59	12	1	28	49	35	25	56	0.28	-0.3	3	5,082	s.	38	nw.	24	8	11	10	5.7	0.4
Southern Plateau.							45.7	-1.2										57	1.28	+0.1										4.0	
El Paso	3,762	110	133	26.20	30.00	+.05	49.6	+0.7	76	27	62	26	2	38	36	38	22	36	0.26	-0.2	3	8,787	nw.	54	w.	17	11	13	5	4.2	T.
Santa Fe	7,013	33	39	23.18	30.03	+.05	33.4	+1.4	58	27	44	-1	14	22	34	28	23	67	0.85	0.0	6	6,980	ne.	43	se.	13	17	9	3	3.6	7.6
Flagstaff	6,907	8	57	23.30	30.01	+.01	28.2	-2.6	60	26	41	-12	11	15	44	24	19	72	2.89	-0.5	7	4,935	sw.	38	s.	9	10	9	10	5.3	19.1
Phoenix	1,108	50	56	28.85	30.02	+.03	54.2	-0.2	83	27	66	30	14	42	37	45	34	52	1.87	+1.2	6	3,063	e.	23	w.	9	15	11	3	4.0	
Yuma	141	9	58	29.89	30.05	+.05	56.2	-3.0	87	26	69	28	14	43	43	45	34	49	0.84	+0.2	4	4,621	w.	34	n.	13	23	4	2	2.4	
Independence	3,910	11	42	26.00	30.03	+.05	40.4	-3.3	70	24	51	23	4	30	35	35	28	65	0.98	-0.3	8	4,503	nw.	40	n.	12	11	10	8	4.8	4.3
Middle Plateau.							33.5	+1.6										69	1.28	+0.2										5.0	
Reno	4,532	56	63	25.44	30.05	-.03	37.0	+1.4	72	26	49	15	13	25	46	31	22	59	0.32	-1.5	5	3,521	w.	45	sw.	28	12	11	6	4.4	3.4
Tonopah	6,089	12	20	24.03	30.16	......	31.4	+3.1	53	27	37	11	13	26	19	29	26	81	1.04	+0.2	8	7,806	se.	36	se.	9	10	11	8	4.5	10.5
Winnemucca	4,344	18	56	25.61	30.06	-.03	36.2	+2.9	69	26	49	12	13	24	46	31	24	66	0.23	-0.7	4	5,032	sw.	44	sw.	28	12	9	8	4.9	2.0
Modena	5,479	10	43	24.59	40.02	-.02	32.8	+1.2	60	26	43	11	15	22	35	29	25	76	1.47	+0.7	3	6,712	w.	48	sw.	29	10	5	14	5.8	12.3
Salt Lake City	4,366	105	110	25.63	30.07	-.01	36.2	+3.3	62	27	44	13	1	29	22	31	24	63	1.24	-0.2	7	3,978	se.	37	nw.	29	10	13	6	4.7	11.8
Durango	6,546	18	56	23.61	30.08	+.08	28.4	-1.5	53	28	41	-5	15	16	38	24	18	68	3.98	+2.5	13	3,552	nw.	26	s.	10	8	12	9	5.5	25.4
Grand Junction	4,608	43	51	25.41	30.07	+.03	32.4	+0.9	63	28	42	6	14	23	29	28	23	70	0.71	+0.1	8	2,964	e.	24	s.	29	12	8	9	5.1	6.0
Northern Plateau.							35.2	+3.1										73	1.15	-0.4										6.4	
Baker City	3,471	48	58	26.45	30.10	-.02	33.6	+5.7	57	26	42	-4	1	26	30	30	25	72	0.30	-1.1	9	4,316	se.	26	se.	29	4	14	11	6.3	3.0
Boise	2,739	78	86	27.21	30.13	+.01	37.8	+4.0	65	26	47	5	1	29	26	32	25	63	0.39	-1.1	5	4,228	se.	26	se.	29	8	1	20	7.0	4.3
Lewiston	757	10	51	29.28	30.11	.00	38.4	+2.2	56	26	46	7	1	31	26	....	....	....	1.32	-0.1	13	3,078	e.	39	nw.	26	4	5	20	7.6	0.5
Pocatello	4,477	46	54	25.50	30.14	+.04	30.0	+1.9	55	27	39	-18	1	21	33	26	21	68	1.34	+0.4	7	6,209	se.	36	sw.	29	11	15	3	4.2	12.4
Spokane	1,929	101	110	28.01	30.11	+.02	32.4	+2.3	51	26	39	-4	1	26	23	30	28	83	1.36	-0.6	15	3,445	ne.	26	sw.	27	1	17	11	6.8	4.5
Walla Walla †	1,000	71	79	29.01	30.14	.00	38.8	+2.4	61	15	46	2	1	31	29	36	33	81	2.07	+0.4	13	3,800	s.	33	se.	5	3	14	12	6.5	2.8
N. Pac. Coast Reg.							41.5	+0.8										82	5.25	-0.4										7.2	
North Head	211	11	56	29.81	30.04	-.02	42.9	+0.8	60	21	47	28	1	39	17	42	40	90	5.11	-0.9	21	12,826	e.	72	se.	5	5	5	19	7.7	
Port Crescent	259	12	29	29.73	30.02	-.01	37.4	+0.2	50	21	44	18	2	31	19	....	....	....	6.26	+1.4	20	3,735	ne.	18	ne.	28	1	9	19	7.6	
Seattle	123	185	224	29.94	30.08	+.02	41.7	+1.2	56	22	47	25	1	36	23	40	37	85	4.24	+0.3	19	5,951	se.	44	sw.	5	3	8	18	7.5	3.0
Tacoma	213	118	120	29.82	30.05	-.01	41.2	+0.8	57	22	47	23	1	35	26	39	36	82	5.02	-0.3	20	3,641	sw.	26	w.	5	7	7	15	6.7	2.0

TABLE I.—*Climatological data for U. S. Weather Bureau stations, February, 1908*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.									Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.				Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
N. P. Coast Reg—Cont.																															
Tatoosh Island	86	7	57	29.89	29.99	−.01	42.4	+1.4	51	16	46	34	2	39	12	40	36	80	9.77	+0.8	21	11,733	e.	56	s.	5	7	2	20	7.8	0.1
Portland, Oreg.	153	68	106	29.91	30.08	.00	42.8	+1.5	60	22	48	25	2	37	21	40	35	76	2.85	−3.1	18	4,899	se.	33	s.	5	3	5	21	7.8	1.8
Roseburg	510	9	57	29.52	30.08	−.02	42.4	−0.2	65	25	52	23	2	33	33	39	36	79	3.53	−1.2	17	1,929	s.	18	se.	29	8	12	9	5.9	
Mid. Pac. Coast Reg.							48.7	−0.9										81	4.32	+0.6										5.4	
Eureka	62	62	80	30.03	30.10	−.01	46.0	+0.8	60	20	52	33	13	40	25	44	42	86	6.59	−0.7	16	4,837	se.	48	n.	19	7	12	10	6.0	
Mount Tamalpais	2,375	11	18	27.56	30.07	−.03	42.9	......	66	26	48	32	12	38	18	41	39	88	5.70	+1.8	11	11,873	nw.	60	nw.	17	11	9	9	5.8	T.
Point Reyes Light	490	7	18	29.51	30.03	......	49.0	......	61	15	53	39	11	45	15	....	....	....	3.38	......	9	15,807	nw.	73	n.	9	4	13	12	6.5	
Red Bluff	332	50	56	29.69	30.06	−.05	48.2	−1.1	73	25	57	32	1	40	33	44	40	76	6.03	+2.3	10	4,349	se.	28	s.	29	12	6	11	5.1	
Sacramento	69	106	117	30.01	30.08	−.01	49.2	−1.0	68	26	56	38	18	42	23	46	43	81	2.75	−0.5	9	6,047	se.	31	ne.	8	8	12	9	5.3	
San Francisco	155	200	204	29.91	30.08	−.02	50.9	−0.4	65	25	56	40	3	45	21	46	42	76	5.39	+1.6	9	4,467	w.	31	sw.	29	11	12	6	4.6	
San Jose	141	78	88	29.93	30.08	......	49.4	−1.2	70	26	58	30	13	41	32	....	....	....	2.46	−1.4	12	4,084	nw.	36	se.	8	11	9	9	4.9	
Southeast Farallon	30	9	17	30.04	30.07	......	50.4	......	58	14	53	44	9	48	11	....	....	....	4.79	+0.9	10	12,537	n.	54	sw.	29	9	10	10	5.7	
S. Pac. Coast Reg.							52.0	−0.6										74	2.85	+0.4										5.1	
Fresno	330	67	70	29.73	30.10	+.02	49.4	+0.2	75	26	59	32	13	40	33	45	40	74	1.75	+0.4	7	1,866	e.	9	sw.	9	13	6	10	4.9	
Los Angeles	338	116	123	29.69	30.06	.00	54.2	+0.1	84	26	64	37	14	45	35	48	43	72	3.66	+0.6	7	3,445	ne.	24	ne.	12	9	8	12	5.9	
San Diego	87	94	102	29.97	30.07	+.01	54.0	−0.6	68	18	60	37	13	48	21	49	44	72	2.41	+0.4	8	4,108	nw.	35	s.	3	19	6	4	3.4	
San Luis Obispo	201	47	54	29.88	30.10	−.01	50.2	−2.3	79	26	60	32	14	41	37	46	42	77	3.59	0.0	10	3,369	nw.	22	se.	9	8	8	13	6.1	
West Indies.																															
Grand Turk	11	6	20	30.04	30.05	−.01	74.8	......	85	21	81	63	17	69	....	....	....	....	5.71	......	21	......	......	....	......	....	....	....	....	....	
San Juan	82	48	90	29.95	30.04	−.01	75.2	......	86	28	81	67	15	69	17	69	67	79	2.84	+0.4	18	6,960	e.	31	e.	10	9	14	6	4.9	
Panama.																															
Ancon	74	....	....	29.80	29.88	......	81.8	......	95	1	92	69	23	71	23	72	70	77	0.24	......	1	6,840	nw.	25	n.	22	13	16	0	3.6	
Bas Obispo	40	....	....	29.72	29.90	......	77.4	......	88	28	86	64	25	68	23	71	68	83	0.11	......	4	4,345	nw.	20	nw.	11	6	22	1	4.5	
Naos	....	....	....	....	....	......	....	......	....	....	....	....	....	....	....	....	....	....	....	......	....	......	......	....	......	....	....	....	....	....	
Christobal	....	....	....	29.89	29.91	......	79.6	......	84	1	83	72	15	77	11	74	72	78	1.08	......	15	11,740	ne.	31	n.	20	14	15	0	3.6	

* More than one date. † Record incomplete.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.80 inch in 1 hour, during February, 1908, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Abilene, Tex.	11			0.07				0.02													
Albany, N. Y	19			0.90														*			
Alpena, Mich.	5-6			0.74														*			
Amarillo, Tex	11			0.10									0.03								
Anniston, Ala.	14			1.26														0.45			
Asheville, N. C.	14-15			0.99														0.31			
Atlanta, Ga.	14	4:25 p. m.	D. N.	1.50	8:55 p. m.	9:20 p. m.	0.76	0.22	0.27	0.34	0.44	0.50	0.53								
Atlantic City, N. J.	19			1.06														0.43			
Augusta, Ga.	10			2.34														*			
Baltimore, Md.	14-15			0.38														0.28			
Bentonville, Ark.	14			1.97														0.42			
Binghamton, N. Y	26			0.66														0.25			
Birmingham, Ala	13-14			1.31														0.43			
Bismarck, N. Dak.	12			0.48														*			
Block Island, R. I	19			1.43														0.25			
Boise, Idaho.	3			0.24														*			
Boston, Mass.	19			0.84														0.19			
Buffalo, N. Y	14-15			1.21														*			
Cairo, Ill	13-14			2.83														0.63			
Canton, N. Y	15			1.24														*			
Charles City, Iowa	4-5			0.68														*			
Charleston, S. C.	13			0.57														0.51			
Charlotte, N. C	18-19			0.96														0.19			
Chattanooga, Tenn	12-13			0.99														0.33			
Cheyenne, Wyo	25-26			0.07														*			
Chicago, Ill	18-19			1.27														*			
Cincinnati, Ohio	14			1.84														0.43			
Cleveland, Ohio	14-15			1.45														0.40			
Columbia, Mo.	18-19			1.11														*			
Columbia, S. C.	1			0.28														0.27			
Columbus, Ohio	14-15			1.46														0.22			
Concord, N. H	1			0.74														*			
Corpus Christi, Tex.	8			0.71					0.30												
Davenport, Iowa	4-5			0.82														*			
Del Rio, Tex.	8			0.56														0.28			
Denver, Colo	12-13			0.04														*			
Des Moines, Iowa	18			0.78														*			
Detroit, Mich.	14-15			1.45														0.14			
Dodge, Kans	13-14			0.41														*			
Dubuque, Iowa	18			0.78														*			
Duluth, Minn.	4-5			0.59														*			
Eastport, Me.	15-16			1.01														0.35			
Elkins, W. Va.	15			0.73														0.30			
Erie, Pa.	14-15			0.95														*			
Escanaba, Mich.	5			1.16														*			
Evansville, Ind	14	D. N.	6:00 p. m.	2.02	2:08 p. m.	2:38 p. m.	0.85	0.10	0.16	0.20	0.28	0.39	0.53								
Fort Smith, Ark.	24-25			1.40														0.29			
Fort Worth, Tex.	11			1.07														*			
Galveston, Tex.	8	6:42 p. m.	D. N.	1.14	10:03 p. m.	10:23 p. m.	0.56	0.11	0.24	0:45	0.56										
Grand Haven, Mich.	5			0.88														*			
Grand Rapids, Mich	5			0.77														*			
Green Bay, Wis.	24-25			0.63														*			
Hannibal, Mo.	13-14			1.37														*			
Harrisburg, Pa.	14-15			1.20														0.42			

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Hartford, Conn	1			1.11														*			
Hatteras, N. C	14-15			0.81														0.48			
Huron, S. Dak	17-18			0.42														*			
Indianapolis, Ind	4-5			1.48														*			
Iola, Kans	18			0.68														0.29			
Jacksonville, Fla	1	3:50 a. m.	6:30 a. m.	0.89	3:57 a. m.	4:26 a. m.	0.02	0.11	0.25	0.44	0.53	0.64	0.70								
Jupiter, Fla	15	9:47 a. m.	12:10 p. m.	1.06	10:34 a. m.	10:59 a. m.	0.07	0.14	0.27	0.37	0.66	0.89									
Kansas City, Mo	13-14			1.41														0.32			
Keokuk, Iowa	18			0.91														*			
Key West, Fla	9-10			0.99														0.37			
Knoxville, Tenn	13-14			1.14														0.30			
La Crosse, Wis	4-5			0.58														*			
La Salle, Ill	18-19			0.82														*			
Lexington, Ky	14			2.28														0.41			
Lincoln, Nebr	17-18			1.02														*			
Little Rock, Ark	4-5			0.62														0.32			
Los Angeles, Cal	9	D. N.	10:12 a. m.	1.28	6:32 a. m.	6:57 a. m.	0.48	0.06	0.20	0.36	0.42	0.47									
Louisville, Ky	14			1.29														0.32			
Lynchburg, Va	14-15			0.73														0.21			
Macon, Ga	14-15			0.68														0.40			
Madison, Wis	4-5			0.80														*			
Marquette, Mich	25-26			0.80														*			
Memphis, Tenn	13-14			1.43														0.29			
Meridian, Miss	14	10:20 a. m.	3:05 p. m.	2.58	10:53 a. m.	12:02 p. m.	0.02	0.16	0.36	0.40	0.41	0.42	0.46	0.47	0.50	0.69	0.75	0.89	1.69		
Milwaukee, Wis	18-19			1.20														*			
Minneapolis, Minn	4-5			0.57														*			
Mobile, Ala	14			0.43					0.31												
Montgomery, Ala	13-14			1.13														0.51			
Mount Weather, Va	25-26			1.02														*			
Nantucket, Mass	15			0.63														0.46			
Nashville, Tenn	14			1.02														0.43			
New Haven, Conn	19-20			2.31														0.57			
New Orleans, La	5			0.61						0.46											
New York, N. Y	19			2.03														0.43			
Norfolk, Va	26			0.63														0.47			
Northfield, Vt	1			1.15														*			
North Head, Wash	4-5			1.00														0.35			
Oklahoma, Okla	13-14			0.98														0.43			
Omaha, Nebr	17-18			0.80														*			
Palestine, Tex	24			0.84					0.32												
Parkersburg, W. Va	14-15			1.10														0.37			
Pensacola, Fla	18-19	3:15 p. m.	1:25 a. m.	0.91	10:25 p. m.	10:50 p. m.	0.35	0.07	0.15	0.29	0.39	0.47									
Peoria, Ill	14			1.21														*			
Philadelphia, Pa	19			0.98														0.26			
Pittsburg, Pa	5			0.80														*			
Portland, Me	15			0.43														0.13			
Portland, Oreg	4-5			1.16														0.32			
Pueblo, Colo	24			0.27														*			
Raleigh, N. C	19			0.78														0.23			
Richmond, Va	15			0.30				0.25													
Rochester, N. Y	14-15			0.61														*			
Sacramento, Cal	8-9			0.70														0.29			
St. Louis, Mo	14			1.13														0.18			
St. Paul, Minn	4-5			0.36									0.03								
Salt Lake City, Utah	10-11			0.65														*			
San Antonio, Tex	8	7:05 a. m.	3:15 p. m.	1.41	12:47 p. m.	1:17 p. m.	0.45	0.22	0.34	0.48	0.50	0.54	0.64								
San Diego, Cal	9			0.88														0.28			
Sandusky, Ohio	14-15			1.31														*			
San Francisco, Cal	8-9			0.95														0.30			
Savannah, Ga	10-11			1.78														0.41			
Scranton, Pa	25-26			1.34														0.20			
Seattle, Wash	4-5			1.25														0.25			
Shreveport, La	4-5			0.75						0.37											
Spokane, Wash	4-5			0.26														*			
Springfield, Ill	14			1.30														*			
Springfield, Mo	13-14			2.25														*			
Syracuse, N. Y	14-15			0.43														*			
Tampa, Fla	15			0.21									0.20								
Taylor, Tex	8	6:00 a. m.	7:10 p. m.	2.68	4:14 p. m.	4:44 p. m.	1.46	0.12	0.31	0.38	0.49	0.62	0.70								
Thomasville, Ga	31†-1	10:40 p. m.	2:20 a. m.	1.84	12:17 a. m.	12:52 a. m.	0.20	0.25	0.52	0.93	1.22	1.36	1.45	1.52							
Toledo, Ohio	14-15			1.96														0.26			
Topeka, Kans	18			0.63														0.16			
Valentine, Nebr	11-12			0.15														*			
Vicksburg, Miss	12	6:52 a. m.	D. N.	3.45	8:53 p. m.	9:51 p. m.	1.82	0.09	0.16	0.28	0.39	0.47	0.63	0.85	0.96	1.08	1.09	1.20			
Washington, D. C	14-15			0.32														0.24			
Wichita, Kans	13-14			1.18														0.42			
Wytheville, Va	4-5			0.71														*			
Yankton, S. Dak	11-12			0.69														*			
San Juan, P. R	3-4			0.88														0.35			

* Self-register not working. † January.

TABLE III.—*Data furnished by the Canadian Meteorological Service, February, 1908.*

Stations.	Pressure, in inches. Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Temperature. Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Precipitation. Total.	Departure from normal.	Total snowfall.
	Ins.	Ins.	Ins.	°	°	°	°	Ins.	Ins.	Ins.
St. Johns, N. F	29.86	30.00	+.17	27.0	+ 5.0	32.8	21.2	5.23	+0.32	15.0
Sydney, C. B. I	29.97	30.01	+.09	24.3	+ 5.0	32.2	16.4	5.92	+0.99	8.0
Halifax, N. S	29.91	30.02	+.07	24.0	+ 1.6	31.9	16.0	6.13	+0.67	11.9
Grand Manan, N. B	29.93	29.99	+.01	24.2	+ 0.8	32.5	15.9	3.35	−0.93	2.8
Yarmouth, N. S	29.93	30.00	+.01	25.4	− 0.4	32.8	18.0	3.17	−1.68	10.9
Charlottetown, P. E. I	29.93	29.97	+.02	19.6	+ 2.0	27.2	12.1	3.02	−0.19	17.0
Chatham, N. B	29.95	29.98	+.02	15.5	+ 3.0	27.3	3.8	3.79	+0.32	14.9
Father Point, Que	29.94	29.97	−.01	12.2	+ 0.7	20.2	4.2	3.14	+0.41	25.2
Quebec, Que	29.67	30.01	+.02	10.8	− 1.0	18.6	3.0	6.22	+2.96	47.1
Montreal, Que	29.82	30.05	+.03	12.2	− 2.3	19.4	5.0	6.22	+2.43	40.6
Rockliffe, Ont.	29.42	30.06	+.05	6.4	− 3.5	19.5	− 6.6	2.75	+0.69	27.5
Ottawa, Ont	29.78	30.13	+.11	10.9	− 0.8	18.8	3.0	4.33	+1.61	34.8
Kingston, Ont.	29.75	30.09	+.05	13.4	− 4.4	22.6	4.0	3.52	+0.88	24.1
Toronto, Ont	29.66	30.06	+.02	19.3	− 2.2	27.3	11.2	3.77	+1.13	26.0
White River, Ont	......	......	......	......	......	......	......	......	......	......
Port Stanley, Ont	29.41	30.08	+.02	19.5	− 3.3	28.0	11.0	4.45	+1.24	31.1
Southampton, Ont.	29.33	......	......	16.7	− 3.2	25.6	7.7	4.25	+1.85	42.1

Stations.	Pressure, in inches. Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Temperature. Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Precipitation. Total.	Departure from normal.	Total snowfall.
	Ins.	Ins.	Ins.	°	°	°	°	Ins.	Ins.	Ins.
Parry Sound, Ont	29.32	30.06	+.05	10.7	− 3.6	21.3	0.1	5.40	+2.48	54.0
Port Arthur, Ont.	29.36	30.10	+.05	13.0	+ 6.6	22.6	3.3	1.67	+0.77	6.5
Winnipeg, Man	29.26	30.14	+.04	8.7	+10.3	18.2	− 0.7	1.80	+0.82	17.5
Minnedosa, Man	28.19	30.11	+.02	10.1	+12.8	20.0	0.2	0.59	−0.02	5.9
Regina, Sask	28.00	......	......	9.5	+10.1	18.7	0.3	1.00	+0.27	10.0
Medicine Hat, Alberta.	......	......	......	......	......	......	......	......	......	......
Swift Current, Sask.	27.43	30.13	+.06	14.8	+ 6.8	23.5	6.1	1.42	+0.68	14.2
Calgary, Alberta	26.37	30.04	+.05	22.3	+ 8.8	33.5	11.1	0.29	−0.34	2.9
Banff, Alberta	25.31	30.11	+.03	17.5	− 1.7	28.0	7.0	1.03	+0.11	10.3
Edmonton, Alberta	27.64	30.02	.00	17.8	+ 9.5	27.4	8.1	0.57	−0.10	5.5
Prince Albert, Sask	28.41	30.04	−.05	9.8	+12.8	21.0	− 1.4	2.15	+1.46	21.5
Battleford, Sask	28.25	30.08	−.01	9.4	+ 9.3	19.1	− 0.2	1.01	+0.64	9.7
Kamloops, B. C.	28.71	29.96	.00	24.9	− 3.4	31.9	17.9	0.97	+0.18	....
Victoria, B. C.	29.91	30.01	+.01	41.0	+ 1.5	45.9	36.1	4.32	+0.22	....
Barkerville, B. C.	......	......	......	......	......	......	......	......	......	....
Hamilton, Bermuda	30.01	30.18	+.07	58.8	− 2.7	64.5	53.0	5.78	+1.34	....
Dawson, Yukon	......	......	......	......	......	......	......	......	......	....

TABLE IV.—*Heights of rivers referred to zeros of gages, February, 1908.*

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
	Miles.	Feet.	Feet.		Feet.		Feet.	Feet.
Republican River.								
Clay Center, Kans. (7)	42	18	7.5	25	5.5	8	6.1	2.0
Smoky Hill-Kansas River.								
Abilene, Kans.	254	22	0.9	21	0.0	1	0.5	0.9
Manhattan, Kans.	160	18	4.5	28	2.4	1,2	3.2	2.1
Topeka, Kans. (5)	87	21	6.2	14-18,21-24	5.6	4,5	6.0	0.6
Missouri River.								
Bismarck, N. Dak.	1,309	14	4.7	25,26	2.2	20	3.3	2.5
Pierre, S. Dak. (29)	1,114	14	......	......	......	......	......	......
Sioux City, Iowa	784	17	8.9	2	7.7	22-24	8.2	1.2
Blair, Nebr.	705	15	7.9	21	5.1	1,12	6.5	2.8
Omaha, Nebr. (10)	669	18	11.1	21	6.1	1	10.2	5.0
St. Joseph, Mo.	481	10	3.4	27	− 2.0	7	0.4	5.4
Kansas City, Mo. (6)	388	21	12.6	24	5.7	14	8.2	6.9
Glasgow, Mo.	231	18	7.4	29	0.9	5	4.1	6.5
Boonville, Mo.	199	20	9.8	27	5.7	1	8.2	4.1
Hermann, Mo. (8)	103	24	12.0	19	4.0	4,5,10,11	7.7	8.0
Minnesota River.								
Mankato, Minn.	127	18	3.8	21	2.4	1-10	3.0	1.4
St. Croix River.								
Stillwater, Minn. (29)	23	11	......	......	......	......	......	......
Illinois River.								
La Salle, Ill. (9)	197	18	25.2	16	15.6	3	21.7	9.6
Peoria, Ill.	135	14	17.2	19	11.8	10-12	14.3	5.4
Conemaugh River.								
Johnstown, Pa. (7)	64	7	13.4	15	2.0	12	3.6	11.4
Allegheny River.								
Warren, Pa.	177	14	12.2	15	1.2	3-12	3.5	11.0
Parker, Pa.	73	20	17.5	16	2.0	1	5.3	15.5
Freeport, Pa.	29	20	28.4	16	3.4	7-9	8.3	25.0
Springdale, Pa	17	—	33.4	16	8.1	2	13.4	25.3
Youghiogheny River.								
Confluence, Pa. (15)	59	10	12.0	15	2.2	25	3.6	9.8
West Newton, Pa. (13)	15	23	17.5	15	2.1	29	5.1	15.4
Monongahela River.								
Fairmont, W. Va.	119	25	22.5	6	15.5	4,5	17.2	7.0
Greensboro, Pa.	81	18	22.0	16	8.3	10,25	10.5	13.7
Lock No. 4, Pa.	40	28	28.5	16	9.5	25	13.3	19.0
Muskingum River.								
Zanesville, Ohio	70	25	24.4	16	8.6	5	13.5	15.8
Little Kanawha River.								
Creston, W. Va. (1)	38	20	16.0	6	3.5	26	5.6	12.5
New-Great Kanawha River.								
Hinton, W. Va.	153	14	12.0	16	2.0	4	4.3	10.0
Charleston, W. Va.	58	30	27.0	16	4.8	4	8.7	22.2
Scioto River.								
Columbus, Ohio (5)	110	17	18.5	15	3.4	24,25	6.7	15.1
Licking River.								
Falmouth, Ky.	30	25	27.6	15	2.8	25	7.4	24.8
Kentucky River.								
Beattyville, Ky	254	30	11.2	6	1.5	24	3.7	9.7
Frankfort, Ky.	65	31	17.5	15	7.0	1,2	9.8	10.5
Wabash River.								
Terre Haute, Ind.	171	16	18.9	20	1.5	4	10.9	17.4
Mount Carmel, Ill. (4)	75	15	23.2	24	5.4	1	18.1	17.8
Cumberland River.								
Burnside, Ky.	518	50	25.4	16	4.5	26	10.8	20.9
Celina, Tenn.	383	45	24.9	18	7.7	25,26	15.0	17.2
Carthage, Tenn.	308	40	24.5	17	7.0	26	13.8	17.5
Nashville, Tenn	193	40	29.5	15	12.1	26	20.3	17.4
Clarksville, Tenn.	126	43	34.7	20	8.7	1	23.7	26.0
Clinch River.								
Speers Ferry, Va.	156	20	8.3	16	1.0	4	2.7	7.3
Clinton, Tenn	52	25	19.5	17	7.4	26	10.4	12.1
South Fork Holston River.								
Bluff City, Tenn.	35	12	4.9	16	1.8	3,5,26,29	2.4	3.1
Holston River.								
Rogersville, Tenn.	103	14	8.8	16	2.8	4,5	3.9	6.0

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
	Miles.	Feet.	Feet.		Feet.		Feet.	Feet.
French Broad River.								
Asheville, N. C.	144	4	5.9	15	0.3	1-3	1.7	5.6
Dandridge, Tenn. (1)	46	12	8.4	16	1.7	5	3.0	6.7
Tennessee River.								
Knoxville, Tenn.	635	12	15.2	16	2.7	5	5.3	12.5
Loudon, Tenn	590	25	13.0	16,17	2.1	5,6	5.0	10.9
Kingston, Tenn	556	25	15.4	16	4.7	1,6	6.8	10.7
Chattanooga, Tenn.	452	33	24.8	17	6.8	1	11.1	18.0
Bridgeport, Ala	402	24	19.9	17	4.9	1	9.0	15.0
Guntersville, Ala.	349	31	27.1	19	7.7	1	14.9	19.4
Florence, Ala.	255	16	17.0	19,20	4.9	1	9.9	12.1
Riverton, Ala.	225	26	28.3	20	7.2	1	16.8	21.1
Johnsonville, Tenn.	95	21	27.1	22	7.6	1	18.5	19.5
Ohio River.								
Pittsburg, Pa.	966	22	30.7	16	2.5	5	8.0	28.2
Coraopolis, Pa.	956	25	31.1	16	4.0	2,5	9.1	27.1
Beaver Dam, Pa.	925	27	41.3	16	6.4	5,6	13.3	34.9
Wheeling, W. Va.	875	36	42.8	17	6.2	3	13.9	36.6
Parkersburg, W. Va	785	36	41.2	18	8.0	5	16.6	33.2
Point Pleasant, W. Va.	703	39	45.7	19	7.7	5	20.7	38.0
Huntington, W. Va	660	50	48.1	19	12.5	5	25.4	35.6
Catlettsburg, Ky.	651	50	49.2	19	13.2	5	25.9	36.0
Portsmouth, Ohio	612	50	50.9	19	14.6	5	27.8	36.3
Maysville, Ky.	559	50	48.9	20	16.2	5	27.8	32.7
Cincinnati, Ohio.	499	50	51.3	20	18.3	1	32.2	33.0
Madison, Ind	413	46	41.5	21	15.9	1	28.7	25.6
Louisville, Ky.	367	28	24.7	21	7.1	1	13.7	17.6
Evansville, Ind.	184	35	40.9	23,24	11.7	1	29.8	29.2
Mount Vernon, Ind. (4)	148	35	41.3	25	11.0	1	32.1	30.3
Paducah, Ky.	47	40	40.9	26	12.1	1,2	29.7	28.8
Cairo, Ill.	1	45	44.9	26	15.7	3	33.0	29.2
Neosho River.								
Iola, Kans.	262	10	3.1	16	0.0	1,11	0.7	3.1
Oswego, Kans.	184	20	9.8	19,26	0.3	10,11	3.1	9.5
Fort Gibson, Okla	3	22	18.5	27	9.0	5-9	12.8	9.5
Canadian River.								
Calvin, Okla.	99	10	4.9	25	3.0	2-8	3.7	1.9
Black River.								
Blackrock, Ark.	67	12	21.5	17	7.3	4	14.8	14.2
White River.								
Calicorock, Ark	272	18	12.2	16	0.9	4	4.4	11.3
Batesville, Ark.	217	18	14.6	16	2.8	4	6.9	11.8
Clarendon, Ark.	75	30	27.5	29	18.1	1	22.4	9.4
Arkansas River.								
Wichita, Kans.	832	10	0.5	19	− 1.4	3,20	−1.0	1.9
Tulsa, Okla.	551	16	8.0	19	2.9	4-6	4.6	5.1
Webbers Falls, Okla.	465	23	13.6	{17,20,21, 27,28}	5.2	1-12	8.8	8.4
Fort Smith, Ark.	403	22	16.0	28	2.4	10-12	7.9	13.6
Dardanelle, Ark.	256	21	15.2	29	2.4	12	7.5	12.8
Little Rock, Ark.	176	23	16.4	19	4.3	1	9.6	12.1
Pine Bluff, Ark.	121	25	19.2	20	6.2	1	11.6	13.0
Yazoo River.								
Greenwood, Miss	175	38	32.7	26,27	10.6	1	23.2	22.1
Yazoo City, Miss.	80	25	22.5	29	7.4	5	15.7	15.1
Ouachita River.								
Camden, Ark.	304	39	27.9	19	9.3	1	20.2	18.6
Monroe, La (*).	122	40	33.2	27-29	......	......	......	......
Red River.								
Denison, Tex.	768	22	4.1	12	1.0	2-5,8,9	1.7	3.1
Arthur City, Tex.	688	27	14.7	13	7.4	7,8	9.9	7.3
Fulton, Ark.	515	28	22.8	18	9.4	1	15.7	13.4
Shreveport, La.	327	29	14.8	20	5.4	2,3	9.9	9.4
Alexandria, La.	118	33	25.5	22	9.9	5	18.9	15.6
Mississippi River.								
Fort Ripley, Minn. (29)	2,082	10	......	......	......	......	......	......
St. Paul, Minn. (29)	1,954	14	......	......	......	......	......	......
Red Wing, Minn (29)	1,914	14	......	......	......	......	......	......

TABLE IV.—*Heights of rivers referred to zeros of gages*—Continued.

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River—Cont'd.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Reeds Landing, Minn.	1,884	12	0.8	25, 26	− 0.5	4-9	0.1	1.3
La Crosse, Wis. (29)	1,819	12	...	...	...	...	...	...
Prairie du Chien, Wis. (29)	1,759	18	...	...	...	...	...	...
Dubuque, Iowa. (29)	1,699	18	...	...	...	...	...	...
Leclaire, Iowa (29)	1,609	10	...	...	...	...	...	...
Davenport, Iowa (12)	1,593	15	11.1	29	7.4	14	9.2	3.7
Muscatine, Iowa	1,562	16	10.4	29	4.0	9-11	6.5	6.4
Galland, Iowa	1,472	8	3.8	29	0.9	11, 12	2.2	2.9
Keokuk, Iowa	1,463	15	6.6	29	0.9	1	4.4	5.7
Warsaw, Ill. (3)	1,458	18	9.6	29	3.2	1	7.3	6.4
Hannibal, Mo. (11)	1,402	13	8.2	27	1.9	1	5.6	6.3
Grafton, Ill	1,306	28	13.4	29	4.7	2	7.9	8.7
St. Louis, Mo	1,264	30	17.4	28	1.7	4	9.3	15.7
Chester, Ill	1,189	30	14.9	29	2.2	4	8.4	12.7
Cape Girardeau, Mo.	1,128	28	21.0	22, 29	5.6	4	13.6	15.4
New Madrid, Mo.	1,003	34	36.2	28	12.6	4	26.2	23.6
Luxora, Ark	905	33	29.6	29	5.6	4	18.3	24.0
Memphis, Tenn	843	33	34.5	29	10.4	5	22.6	24.1
Helena, Ark.	767	42	42.3	29	14.2	6	27.8	28.1
Arkansas City, Ark.	635	42	43.7	29	18.1	8	30.2	25.6
Greenville, Miss.	595	42	37.0	29	14.4	8	24.8	22.6
Vicksburg, Miss.	474	45	40.4	29	16.5	9	27.3	23.9
Natchez, Miss.	373	46	39.4	29	19.7	11	28.3	19.7
Baton Rouge, La.	240	35	28.8	29	15.2	12	21.2	13.6
Donaldsonville, La	188	28	22.8	29	11.4	11	16.2	11.4
New Orleans, La.	108	16	14.7	29	7.4	11, 12	10.5	7.3
Atchafalaya River.								
Simmesport, La.	127	33	33.6	29	19.5	11	25.9	14.1
Melville, La.	103	31	33.0	29	22.5	11	27.7	10.5
Hudson River.								
Troy, N. Y	154	14	18.2	16	3.5	6, 8	9.2	14.7
Albany, N. Y.	147	12	16.7	16	0.7	10	6.5	16.0
Delaware River.								
Hancock (E. Branch), N. Y.	287	12	10.7	16	3.6	29	4.6	7.1
Hancock (W. Branch), N. Y.	287	10	10.3	16	3.4	26	4.8	6.9
Port Jervis, N. Y.	215	14	11.8	16	0.8	1	2.8	11.0
Phillipsburg, N. J. (11)	146	26	18.5	16	2.2	13, 14	5.6	16.3
Trenton, N. J.	92	18	10.0	16, 17	2.5	2	4.3	7.5
North Branch Susquehanna.								
Binghamton, N. Y.	183	14	14.0	16	2.5	1, 3	4.3	11.5
Wilkes-Barre, Pa.	60	17	21.8	17	5.9	13, 14	8.6	15.9
West Branch Susquehanna.								
Williamsport, Pa.	39	20	17.0	16	2.1	2, 13, 14	4.4	14.9
Susquehanna River.								
Harrisburg, Pa.	69	17	15.0	16	1.4	4	5.1	13.6
Shenandoah River.								
Riverton, Va.	56	22	12.7	16	0.1	11-13	1.9	12.6
Potomac River.								
Cumberland, Md.	290	8	9.2	15	3.0	1-12, 29	3.8	6.2
Harpers Ferry, W. Va.	172	18	18.5	16	1.8	13, 14	5.3	16.7
James River.								
Lynchburg, Va.	260	20	15.0	16	1.8	9-12	3.5	13.2
Columbia, Va.	167	18	26.1	16	4.7	10-12	8.8	21.4
Richmond, Va.	111	10	13.9	17	0.5	3	2.9	13.4
Roanoke River.								
Clarksville, Va	196	12	9.2	17	1.1	5	3.1	8.1
Weldon, N. C.	129	30	37.4	18	13.2	1	19.5	24.2
Tar River.								
Greenville, N. C.	21	22	12.4	20, 21	8.0	14	10.3	4.4
Deep River.								
Moncure, N. C.	171	25	17.0	16	8.6	11	10.1	8.4
Cape Fear River.								
Fayetteville, N. C	112	38	29.3	17	8.0	1, 11	15.1	21.3
Pedee River.								
Cheraw, S. C	149	27	31.3	17	4.7	1	14.8	26.6
Smiths Mills, S. C.	51	16	18.1	25, 26	11.2	4	14.1	6.9
Lynch Creek.								
Effingham, S. C.	35	12	15.0	19, 20	6.0	1	10.0	9.0
Black River.								
Kingstree, S. C.	45	12	10.0	18, 19	7.5	1	8.5	2.5
Catawba-Wateree River.								
Mount Holly, N. C.	143	15	9.8	15	1.8	1	3.3	8.0
Catawba, S. C	107	11	15.6	16	2.7	6	5.9	12.9
Camden, S. C.	37	24	29.0	17	8.5	6	17.4	20.5
Congaree River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Columbia, S. C	52	15	14.6	17	2.3	9	6.8	12.3
Savannah River.								
Calhoun Falls, S. C.	347	15	9.1	16	4.0	7, 29	5.2	5.1
Augusta, Ga.	268	32	27.6	2	11.0	9, 10	16.9	16.6
Oconee River.								
Dublin, Ga	79	30	18.5	5	6.8	28, 29	12.6	11.7
Ocmulgee River.								
Macon, Ga.	203	18	18.7	1	6.4	10	11.1	12.3
Abbeville, Ga.	96	11	14.8	8	8.2	1	12.5	6.6
Flint River.								
Montezuma, Ga.	152	20	17.0	4	7.0	1	11.3	10.0
Albany, Ga.	90	20	21.6	6	6.3	1	15.2	15.3
Bainbridge, Ga.	29	22	20.0	6	10.6	1	17.1	9.4
Chattahoochee River.								
West Point, Ga	239	20	12.9	16	4.4	9	7.2	8.5
Eufaula, Ala	90	40	34.0	2	6.2	29	16.6	27.8
Alaga, Ala.	30	25	32.0	3	11.5	10	18.2	20.5
Coosa River.								
Rome, Ga.	266	30	21.7	16	4.0	5, 9	9.2	17.7
Gadsden, Ala.	162	22	20.8	17	6.7	9	12.0	14.1
Lock No. 4, Ala.	113	17	17.3	15	5.5	9	9.9	11.8
Wetumpka, Ala	12	45	37.9	17	12.4	9	22.8	25.5
Alabama River.								
Montgomery, Ala.	323	35	37.4	17	9.6	10	20.8	27.8
Selma, Ala	246	35	43.0	20	10.9	1	25.7	32.1
Black Warrior River.								
Tuscaloosa, Ala.	90	43	52.5	16	12.8	1	28.9	39.7
Tombigbee River.								
Columbus, Miss	316	33	23.2	20	3.5	1	12.5	19.7
Demopolis, Ala.	168	35	52.1	26	15.5	1	36.2	36.6
Pascagoula River.								
Merrill, Miss.	78	20	21.4	20, 21	9.6	1	18.2	11.8
Pearl River.								
Columbia, Miss.	110	18	20.4	18	6.0	1	16.0	14.4
Sabine River.								
Logansport, La.	315	25	25.3	17	8.6	1	20.0	16.7
Neches River.								
Beaumont, Tex.	18	10	6.9	17-19	1.2	1	4.4	5.7
Trinity River.								
Dallas, Tex.	320	25	27.4	14	5.4	7, 8	10.9	22.0
Long Lake, Tex.	211	35	36.6	19	5.6	1	26.1	31.0
Liberty, Tex	20	25	26.6	17-19	7.9	1, 2	20.8	18.7
Brazos River.								
Waco, Tex.	285	22	6.6	12	3.4	4	4.4	3.2
Hempstead, Tex	140	40	25.0	12	3.3	4	10.8	21.7
Booth, Tex	61	39	22.4	13	4.3	1	9.8	18.1
Colorado River.								
Austin, Tex.	214	18	3.5	12	1.3	2, 3, 6-8	2.0	2.2
Columbus, Tex.	98	24	20.8	10	5.8	2-8	8.8	15.0
Red River of the North.								
Moorhead, Minn. (29)	284	26	...	...	...	...	...	...
Snake River.								
Lewiston, Idaho	144	24	2.4	28, 29	1.2	2, 3	1.8	1.2
Riparia, Wash.	67	30	3.2	29	1.5	4	2.5	1.7
Columbia River.								
Wenatchee, Wash	473	40	3.8	1	3.0	5-7	3.3	0.8
Umatilla, Oreg	270	25	1.6	29	0.1	9-11	0.6	1.5
The Dalles, Oreg.	166	40	0.9	29	− 0.5	5	0.4	1.4
Willamette River.								
Albany, Oreg.	118	20	7.8	8	3.6	4, 27	4.9	4.2
Portland, Oreg.	12	15	5.4	7	1.4	25	3.6	4.0
Sacramento River.								
Red Bluff, Cal.	265	23	22.0	10	3.9	25	7.7	18.1
Colusa, Cal	156	28	25.3	11	11.1	26	17.1	14.2
Knights Landing, Cal.	99	18	15.7	12, 13	10.9	28	14.0	4.8
Sacramento, Cal.	64	25	20.4	13	16.4	28, 29	18.9	4.0
San Joaquin River.								
Pollasky, Cal.	203	10	0.9	3	0.0	{1, 2, 7, 8, 11, 12, 14-18, 24, 25}	0.1	0.9
Firebaugh, Cal	148	12	2.6	6	1.2	20, 21, 26-28	1.8	1.4
Lathrop, Cal.	49	14	7.1	12	4.1	25-27	5.3	3.0

Figures denote number of days frozen. (o) 15 days missing.

Honolulu, T. H., latitude 21° 19' north, longitude 157° 30' west; barometer above sea, 38 feet; gravity correction, —0.057 inch, applied. February, 1908.

Day.	Pressure, in inches *		Air temperature, degrees Fahrenheit.				Moisture.				Wind, in miles per hour.				Precipitation, inchs.		Clouds.					
							8 a. m.		8 p. m.		8 a. m.		8 p. m.				8 a. m.			8 p. m.		
	8 a. m.	8 p. m.	8 a. m.	8 p. m.	Maximum.	Minimum.	Wet.	Relative humidity.	Wet.	Relative humidity.	Direction.	Velocity.	Direction.	Velocity.	8 a. m.	8 p. m.	Amount.	Kind.	Direction, from.	Amount.	Kind.	Direction, from.
							°	%	°	%												
1	30.08	30.06	71.2	71.5	77	64	64.2	68	65.0	70	ne.	8	n.	3	0.09	0.11	2 3	Cu. Cu.-n.	ne. se.	1	S.	ne.
2	30.06	30.02	70.0	69.5	73	68	61.0	59	60.5	59	ne.	13	ne.	12	0.00	0.00	10	Cu.	ne.	3	S.	ne.
3	30.00	30.01	70.0	63.5	74	64	63.5	70	62.0	92	e.	2	ne.	6	0.05	0.43	2	Cu.	ne.	10	N.	ne.
4	30.07	30.09	71.0	71.5	77	66	65.0	72	65.0	70	n.	4	e.	3	0.08	0.00	1 1	A.-s. Cu.	sw. ne.	1	Cu.	ne.
5	30.14	30.12	71.0	72.0	76	65	64.0	68	64.0	65	e.	9	e.	10	0.10	0.04	7 3	A.-s. Cu.	nw. ne.	5	Cu.	ne.
6	30.11	30.08	71.7	67.5	73	66	64.2	67	65.0	88	e.	9	ne.	9	0.01	0.11	10	Cu.	ne.	9	N.	e.
7	30.06	30.06	70.5	71.5	75	67	64.5	72	65.0	70	ne.	8	e.	9	0.02	T.	4	Cu.	e.	10	Cu.	se.
8	30.08	30.08	73.2	71.2	78	68	65.0	64	66.0	76	e.	7	ne.	20	0.03	0.02	5 2	A.-cu. Cu.	sw. e.	5	A.-s.	nw.
9	30.07	30.04	71.1	69.0	76	68	67.0	80	66.0	85	e.	15	e.	8	0.01	0.51	10	A.-s.	e.	5	Cu.	ne.
10	30.08	30.06	69.0	70.0	77	65	66.0	85	68.0	90	e.	7	nw.	6	0.89	0.30	9	A.-cu.	se.	10	S.	e.
11	30.09	30.09	72.0	73.0	77	67	66.2	74	69.0	82	se.	3	ne.	2	T.	0.00	0	0	0	10	S.	ne.
12	30.15	30.15	75.0	72.0	80	70	67.7	67	67.5	79	ne.	2	ne.	5	0.00	T.	1	Cu.	e.	7	Cu.	ne.
13	30.17	30.14	74.4	72.5	78	70	67.0	68	66.0	71	e.	4	ne.	9	0.00	0.00	3	Cu.	e.	7	Cu.	ne.
14	30.14	30.12	73.0	71.5	78	69	65.2	66	64.0	66	e.	8	e.	6	0.00	0.00	7	Cu.	e.	Few	Cu.	ne.
15	30.11	30.10	73.6	71.5	77	70	64.2	60	65.0	70	ne.	8	e.	8	0.00	0.00	2	Cu.	e.	8	Cu.	ne.
16	30.12	30.11	72.0	71.5	76	68	63.0	61	64.5	68	e.	7	e.	18	0.00	0.00	1 2	A.-s. Cu.	0 e.	2	Cu.	e.
17	30.15	30.13	72.0	71.7	77	70	62.2	58	64.0	66	e.	18	ne.	8	0.00	0.00	5	Cu.	e.	5	Cu.	ne.
18	30.13	30.08	72.5	71.0	78	68	62.0	55	63.0	64	e.	11	e.	13	T.	0.00	Few	Cu.	e.	2 1	Ci. Cu.	nw. ne.
19	30.11	30.08	73.2	70.5	78	68	61.2	50	64.0	70	e.	3	e.	2	0.00	0.00	1	Ci.-s.	0	7	S.	e.
20	30.06	30.05	71.0	71.5	77	65	64.0	68	64.0	66	ne.	3	se.	1	0.00	0.00	1	Ci.	se.	6	S.	s.
21	30.06	30.07	71.2	70.0	76	65	64.2	68	64.0	72	n.	2	ne.	3	0.00	0.00	2	Ci.-cu.	ne.	0	0	0
22	30.07	30.02	75.2	72.0	78	66	66.1	62	65.0	69	e.	2	e.	2	0.00	0.00	4	Cu.	e.	7	S.	ne.
23	30.06	30.01	74.0	70.0	78	66	66.0	65	65.5	79	e.	3	n.	3	0.00	0.00	1 2	A.-s. A.-cu	0 e.	0	0	0
24	30.00	29.95	73.0	71.5	78	66	63.3	58	63.0	62	ne.	2	e.	5	0.00	0.00	1 1	A.-s. Cu.	0 0	Few	A.-s.	0
25	29.98	29.94	73.0	68.5	77	67	67.0	73	67.0	92	e.	4	e.	6	0.00	0.25	6 2	A.-cu. Cu.	se e.	10	N.	0
26	29.98	29.95	73.7	72.5	76	69	67.0	70	69.0	84	s.	12	ne.	2	0.01	0.09	2 1	Ci.-cu. Cu.	0 s.	7	S.	e.
27	29.94	29.91	74.2	69.5	75	68	68.2	74	67.0	88	w.	3	ne.	3	0.00	0.29	9	S.-cu.	s.	0	0	0
28	29.91	29.90	73.0	70.0	77	66	66.0	69	63.0	68	ne.	4	ne.	9	0.00	T.	Few	Cu.	0	Few	A.-s.	0
29	29.94	29.95	71.0	71.8	80	65	63.6	66	64.0	66	s.	2	n.	3	0.00	0.00	Few	Cu.	0	0	0	0
30																						
31																						
Mean	30.066	30.047	72.3	70.7	76.8	67.0	64.8	66.8	65.0	74.0	e.	6.1	ne., e.	6.7	1.29	2.15	4.3	Cu.	e.	5.1	Cu.	ne.

Observations are made at 8 a.m. and 8 p. m., local standard time, which is that of 157° 30' west, and is 5h and 30m slower than 75th meridian time. *Pressure values are reduced to sea level and standard gravity.

7——5

Chart I. Hydrographs for Seven Principal Rivers of the United States, February, 1908.

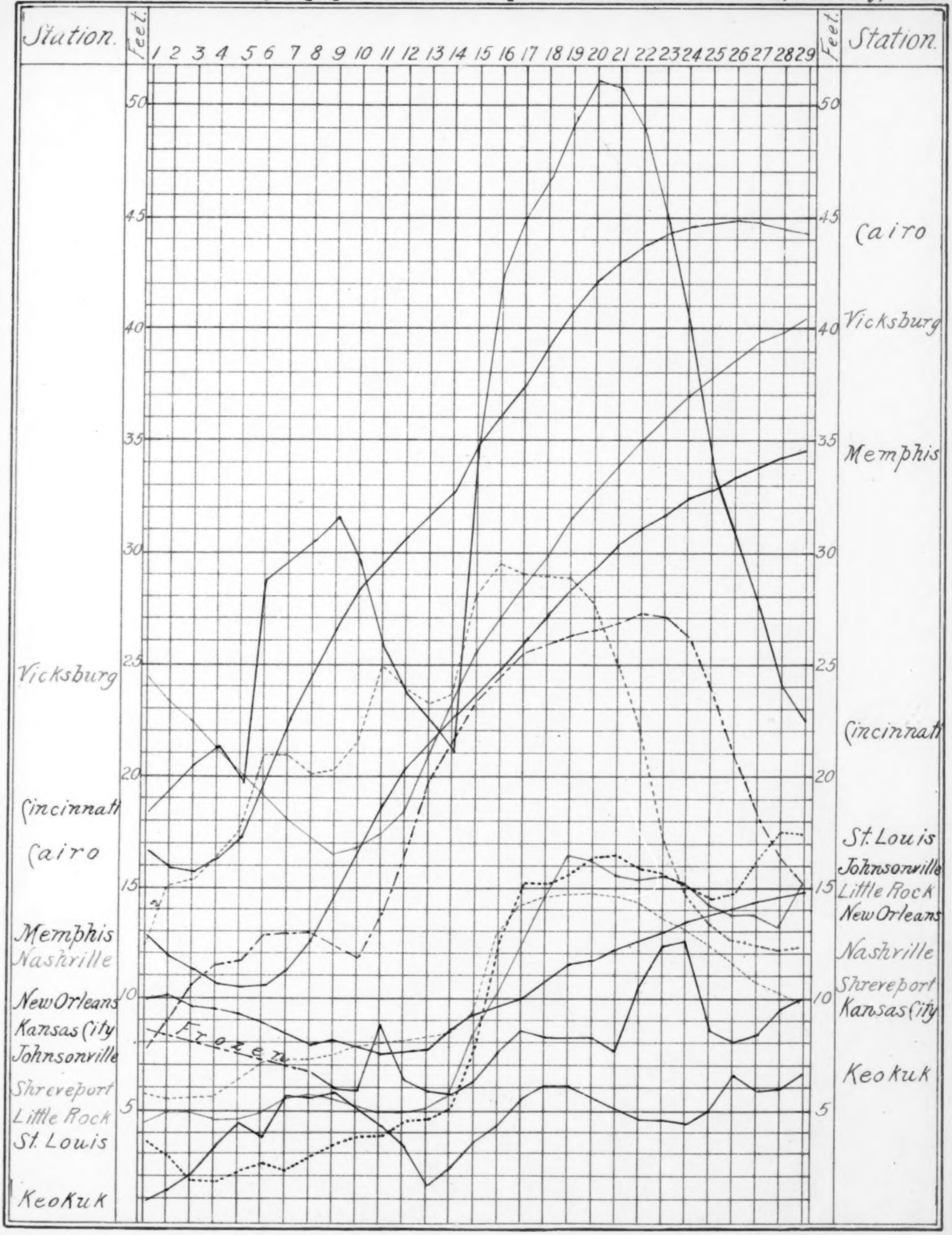

Chart II. Tracks of Centers of High Areas, February, 1908.

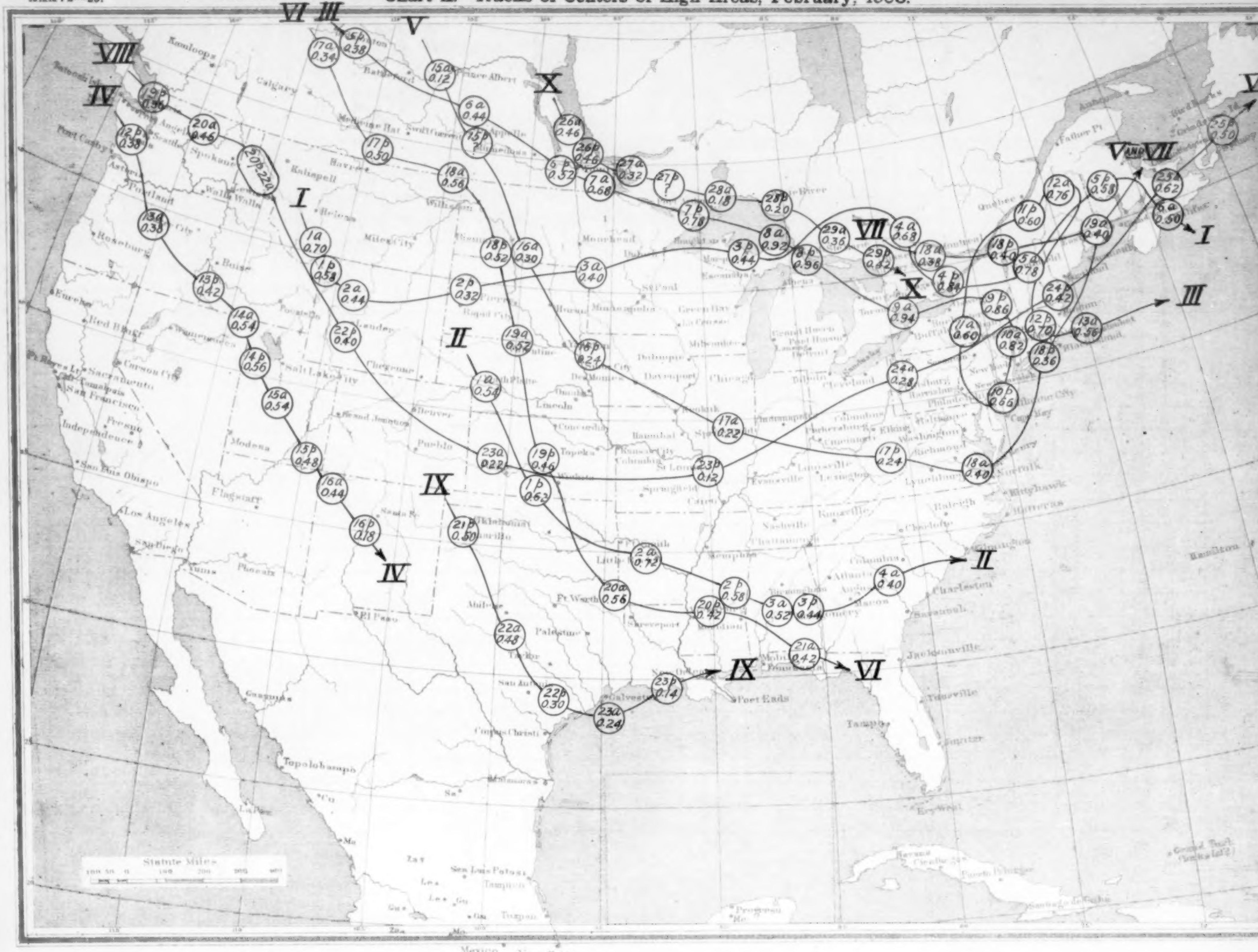

Chart III. Tracks of Centers of Low Areas, February, 1908.

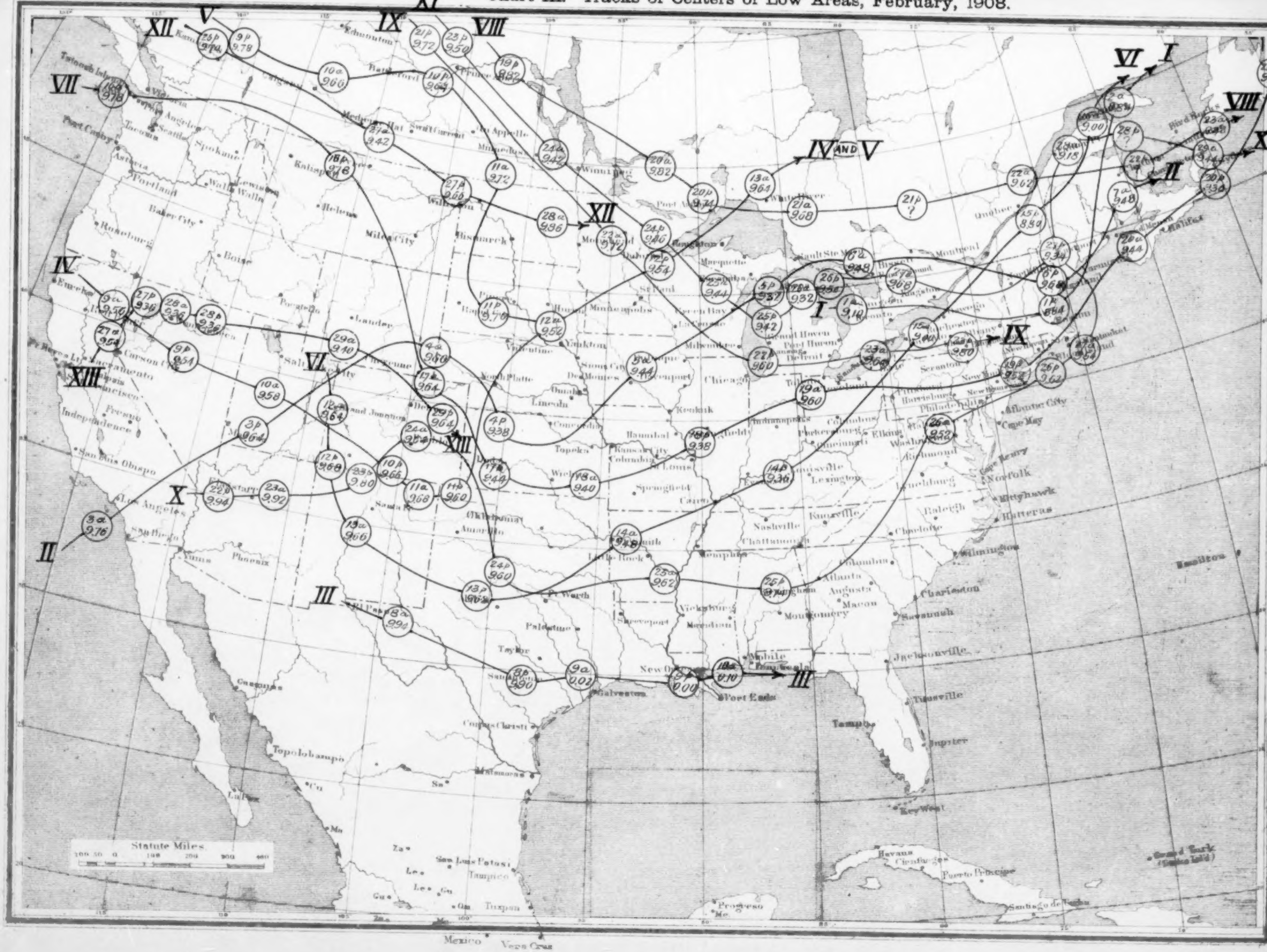

Chart IV. Total Precipitation, February, 1908.

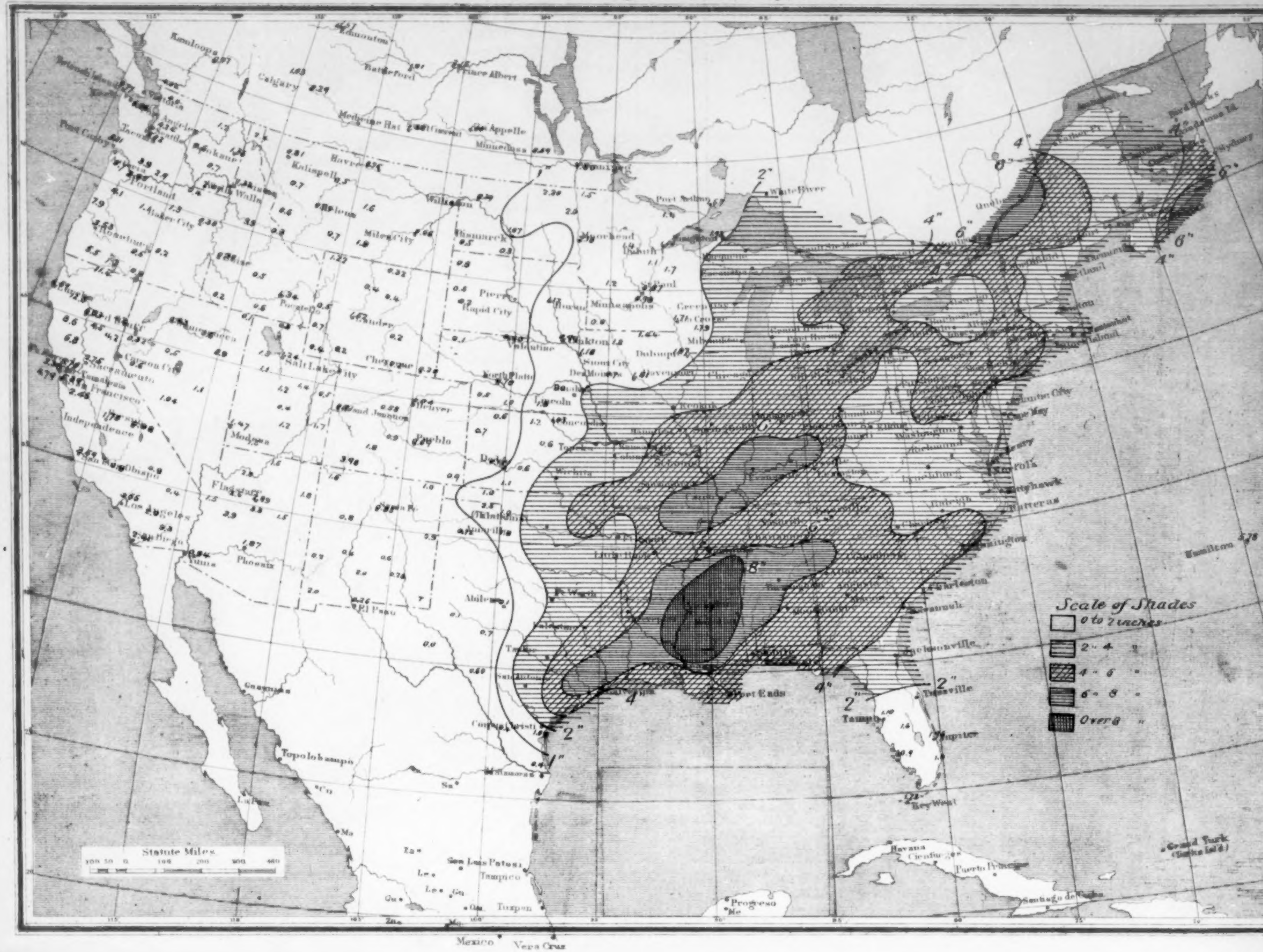

Chart V. Percentage of Clear Sky between Sunrise and Sunset, February, 1908.

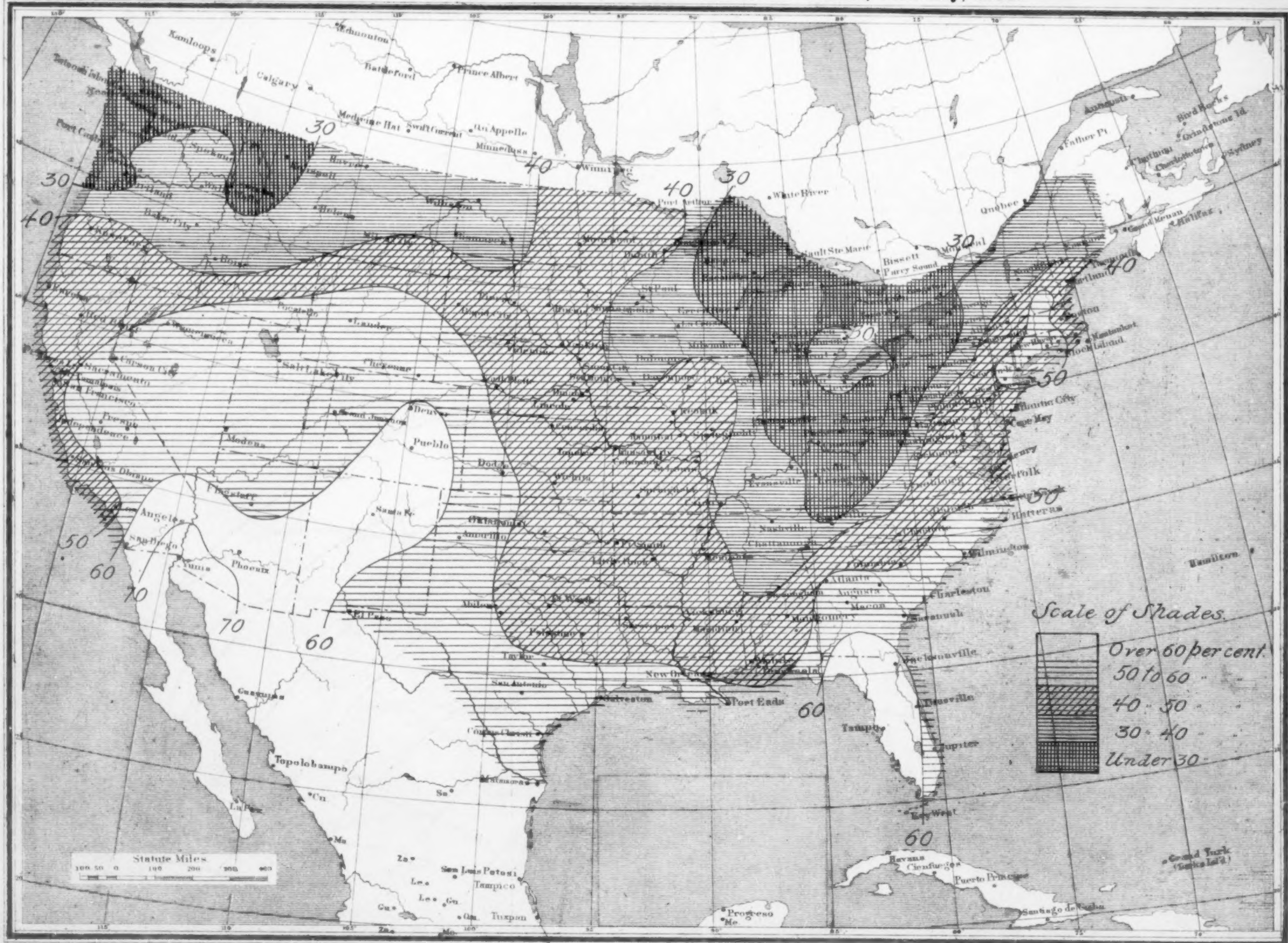

Chart VI. Isobars and Isotherms at Sea Level; Prevailing Winds, February, 1908.

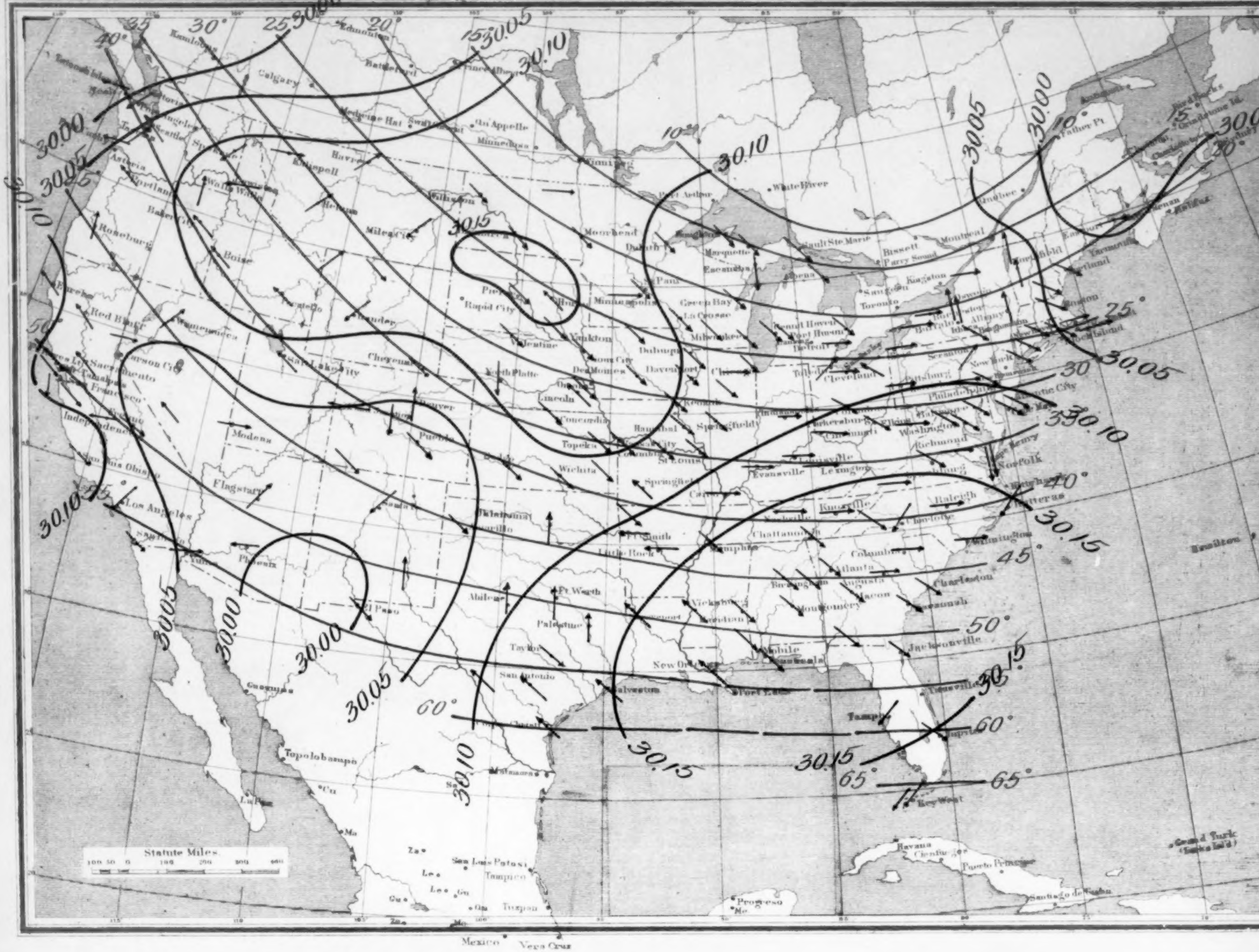

Chart VII. Total Snowfall for February, 1908.

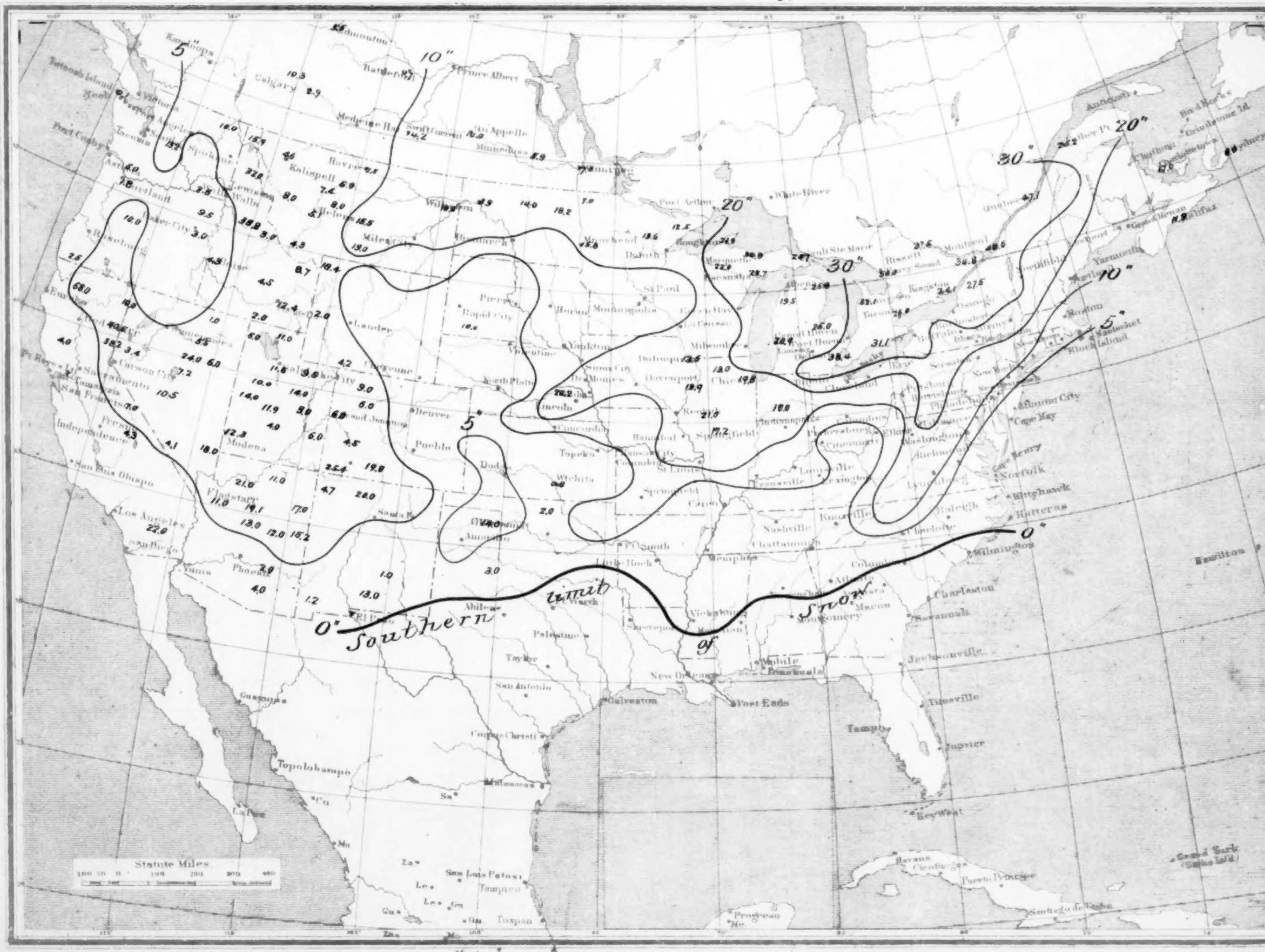

Chart VIII. Depth of Snow on Ground, February 29, 1908.

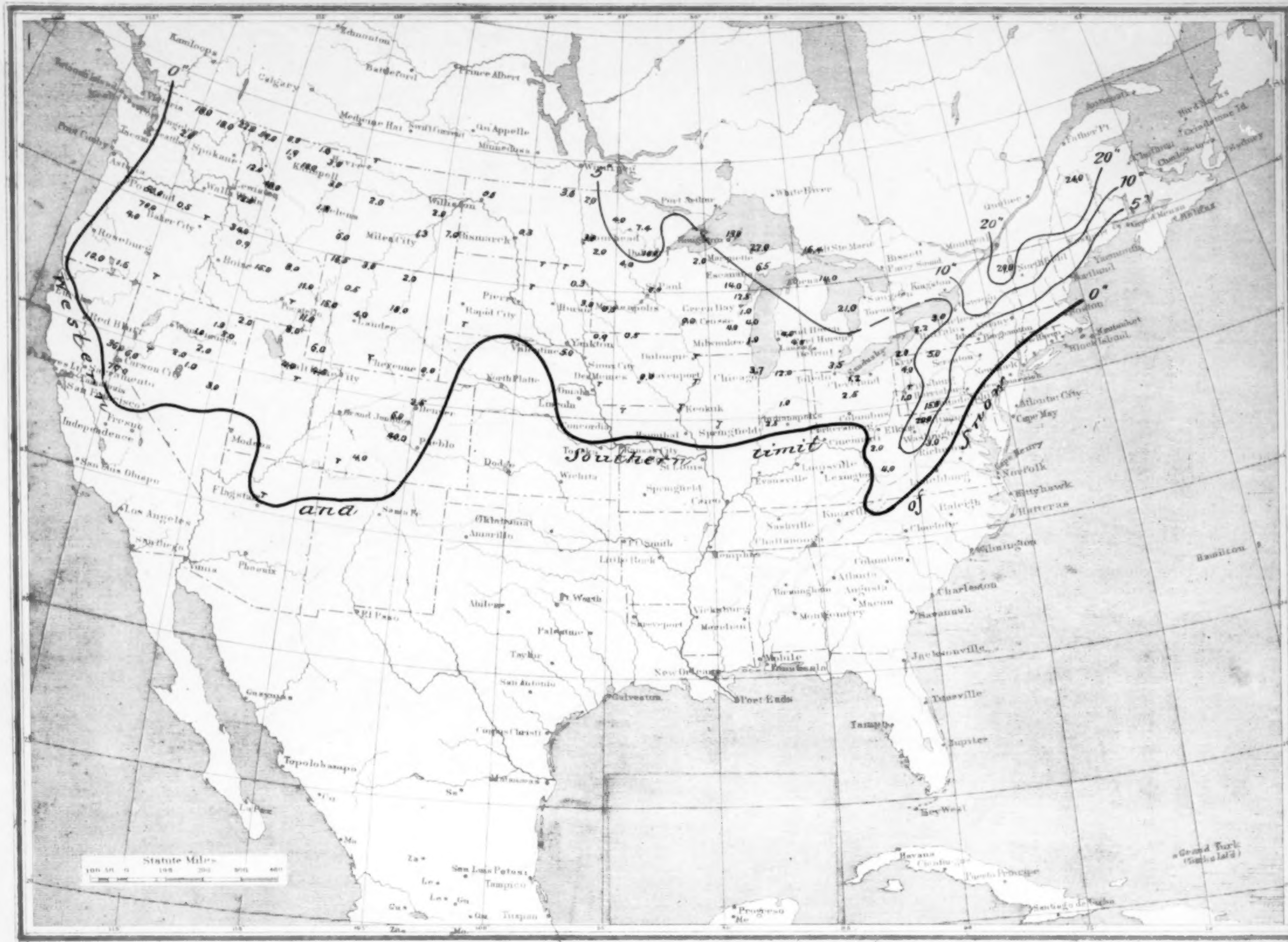

Chart IX. OBSERVATIONS AT THE RENO RESERVOIR, AUGUST 1-10, 12-17, 1907.

Fig. 6. Vapor pressure at 1 a. m. Fig. 7. Vapor pressure at 5 a. m.

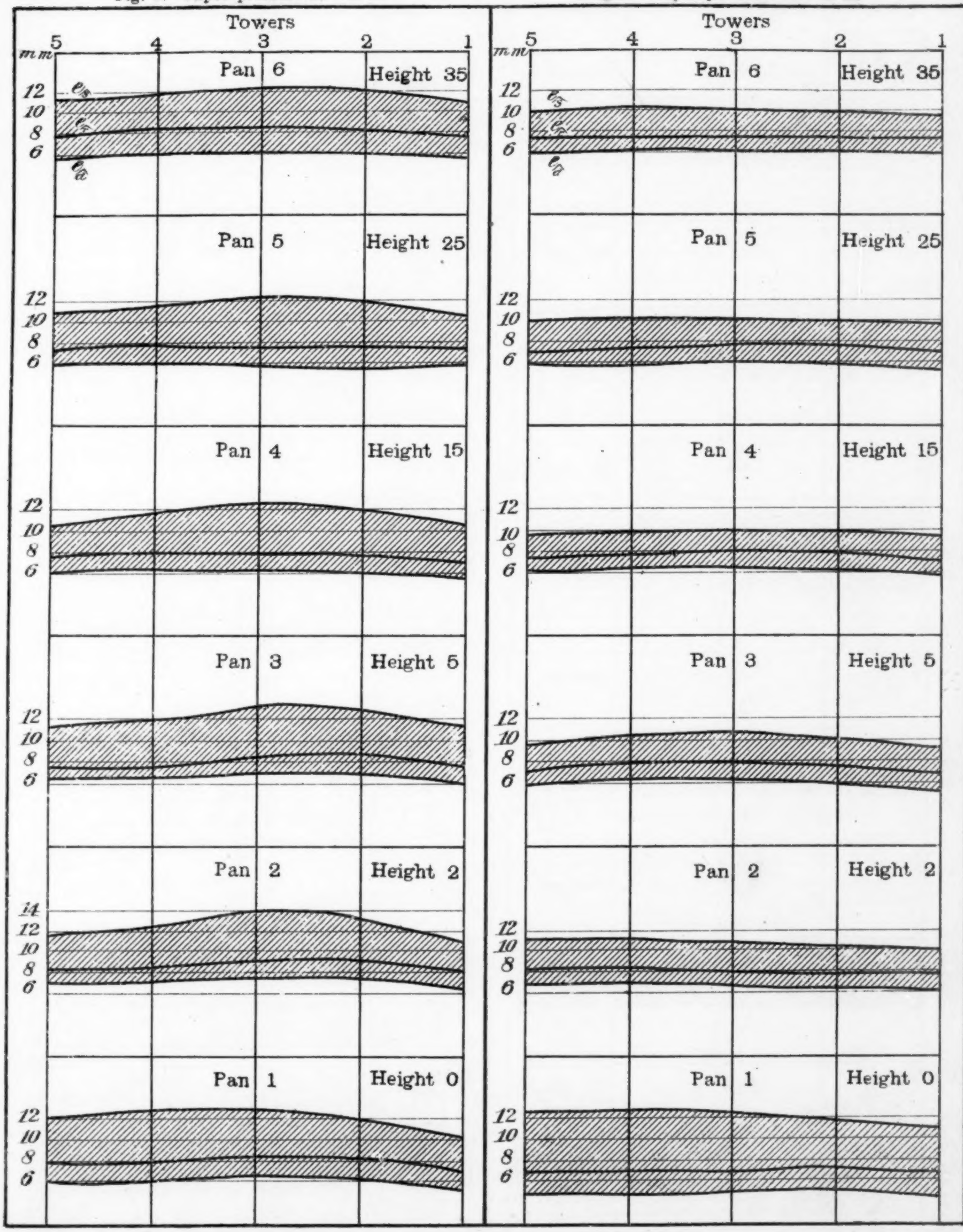

Chart X. OBSERVATIONS AT THE RENO RESERVOIR, AUGUST 1-10, 12-17, 1907.

Fig. 8. Vapor pressure at 8 a. m.

Fig. 9. Vapor pressure at 11 a. m.

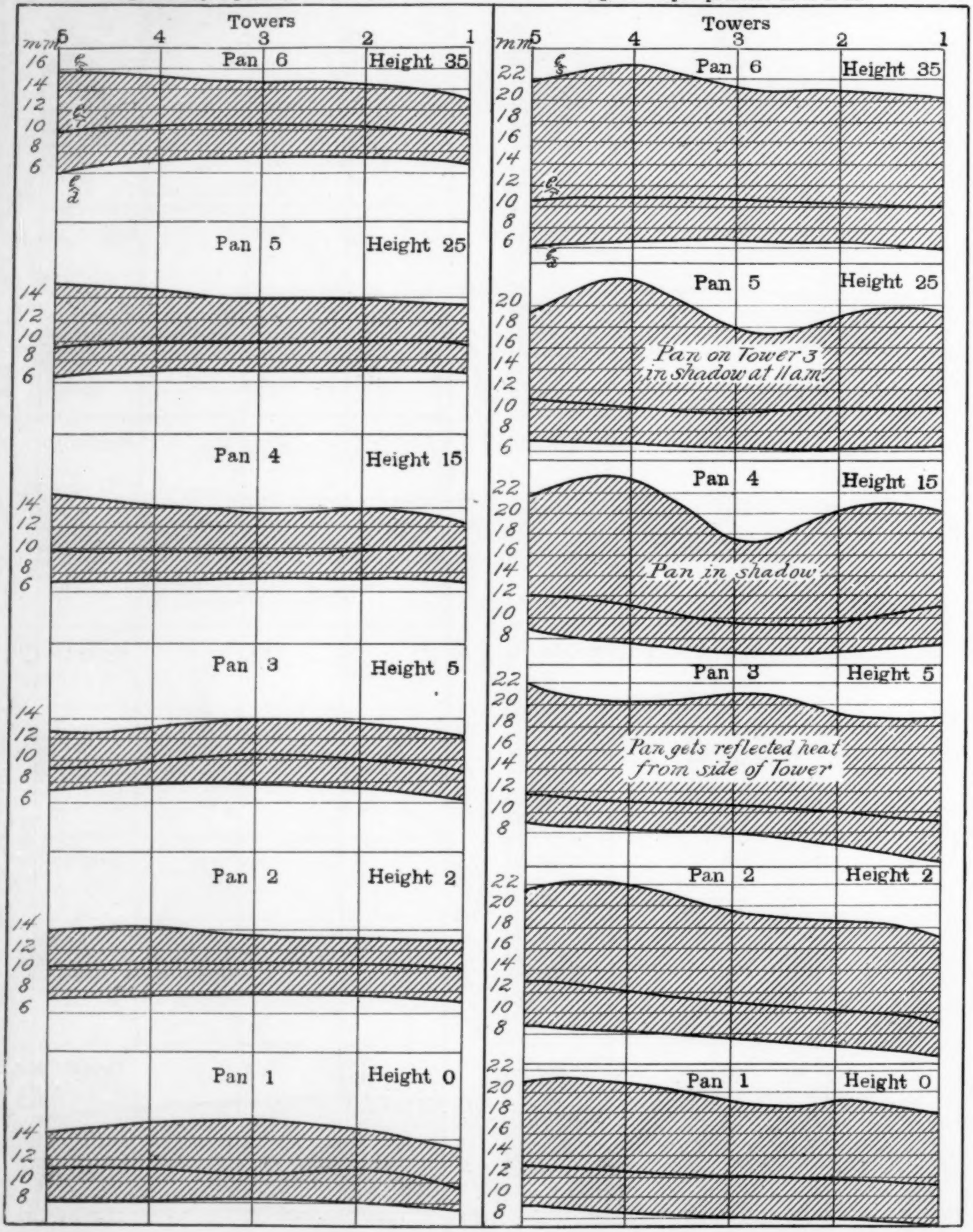

Chart XI. OBSERVATIONS AT THE RENO RESERVOIR, AUGUST 1-10, 12-17, 1907.

Fig. 10. Vapor pressure at 2 p. m.

Fig. 11. Vapor pressure at 5 p. m.

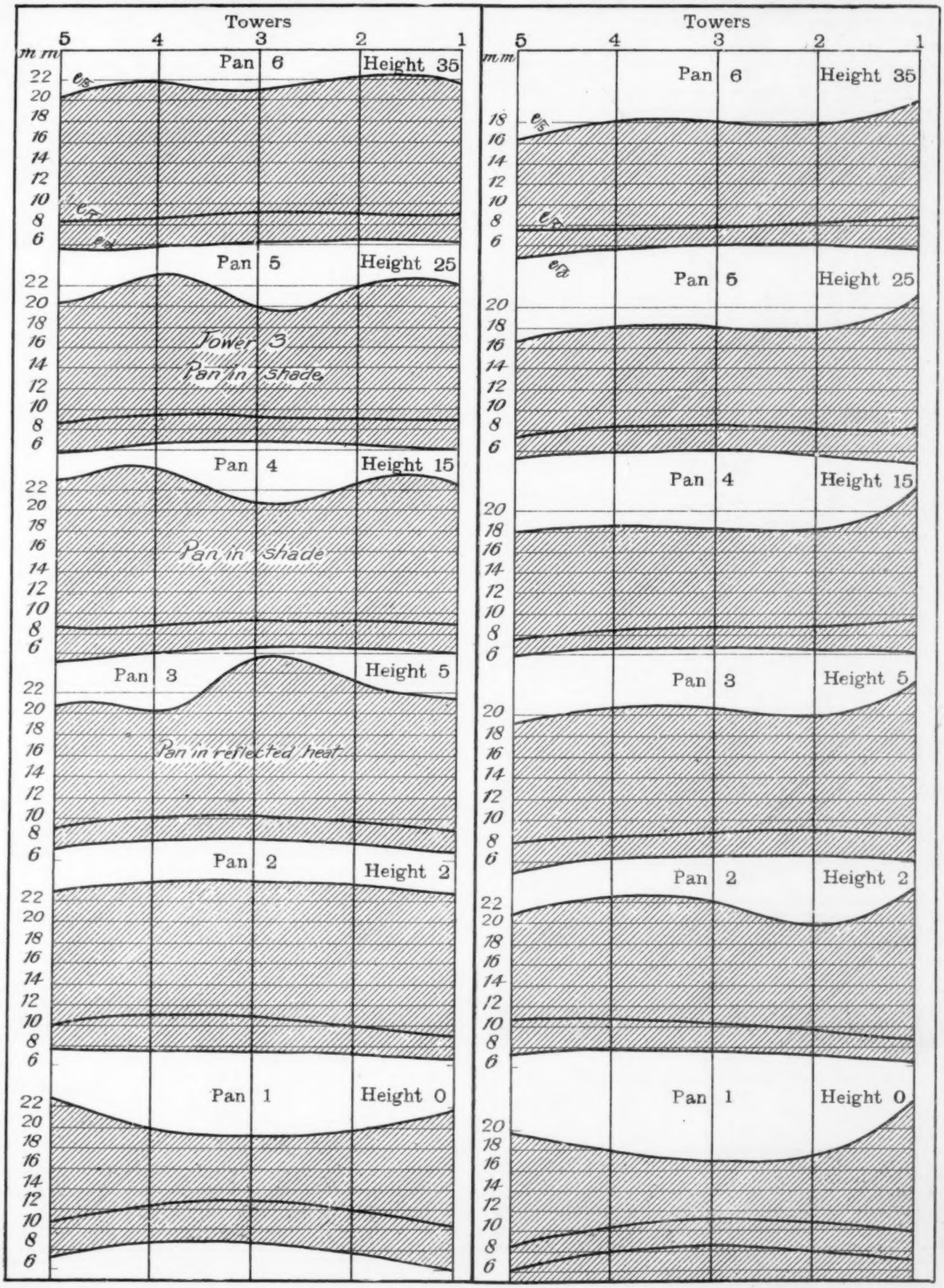

Chart XII. OBSERVATIONS AT THE RENO RESERVOIR, AUGUST 1-10, 12-17, 1907. XXXVI—20.

Fig. 12. Vapor pressure at 8 p. m.

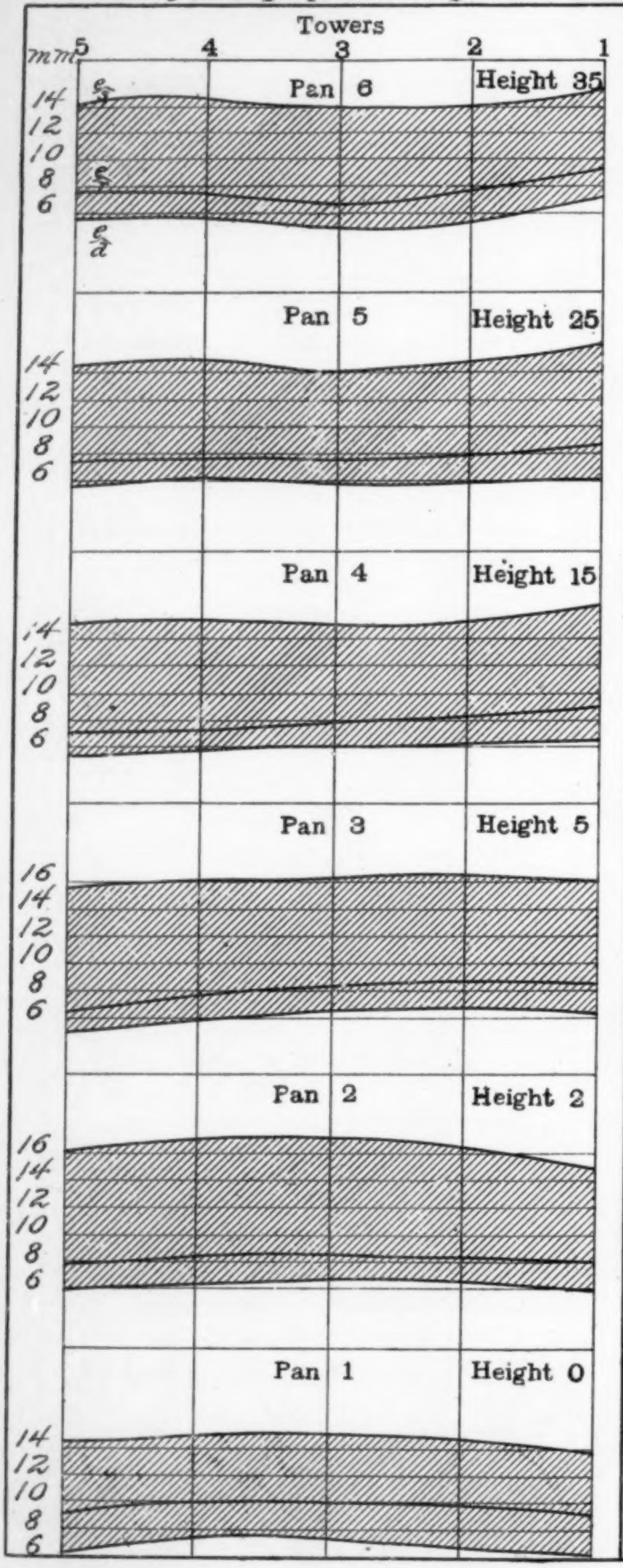

Fig. 13. Evaporation, 8 p. m. to 1 a. m.

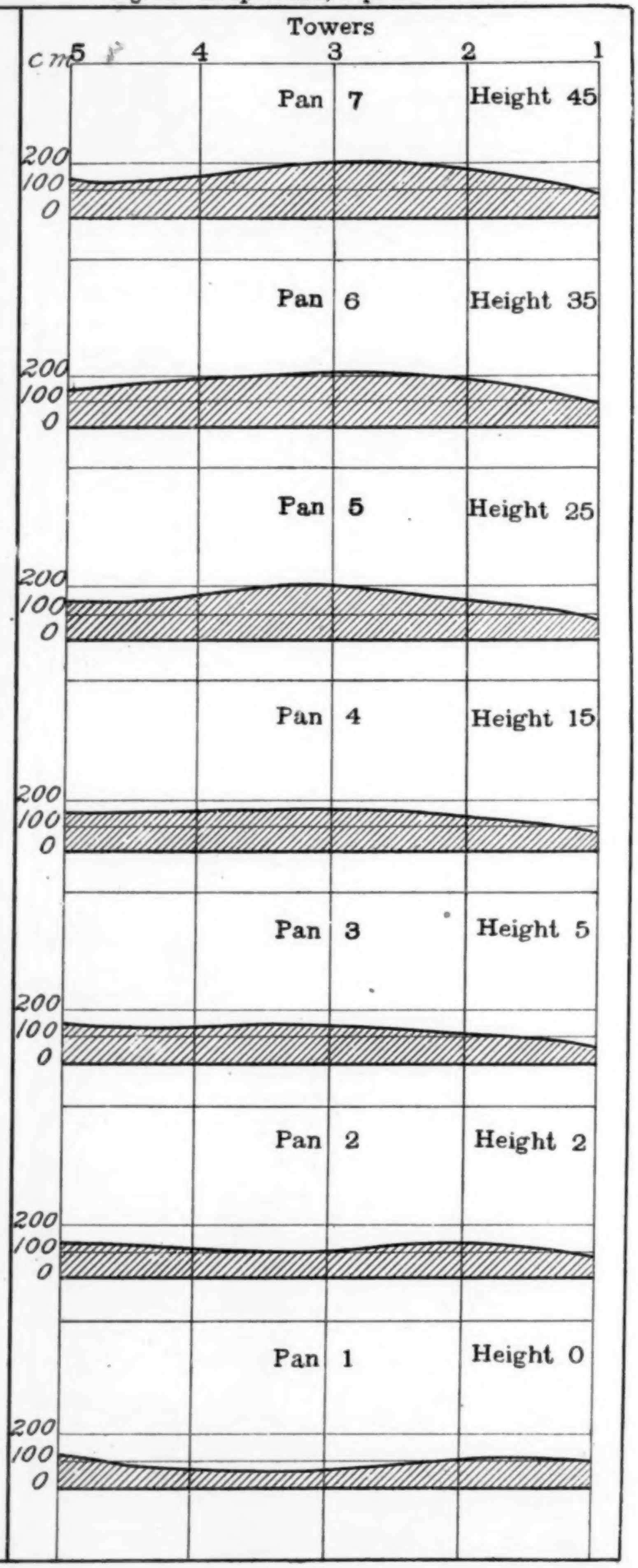

Chart XIII. OBSERVATIONS AT THE RENO RESERVOIR, AUGUST 1-10, 12-17, 1907.

Fig. 14. Evaporation, 1 a. m. to 5 a. m.

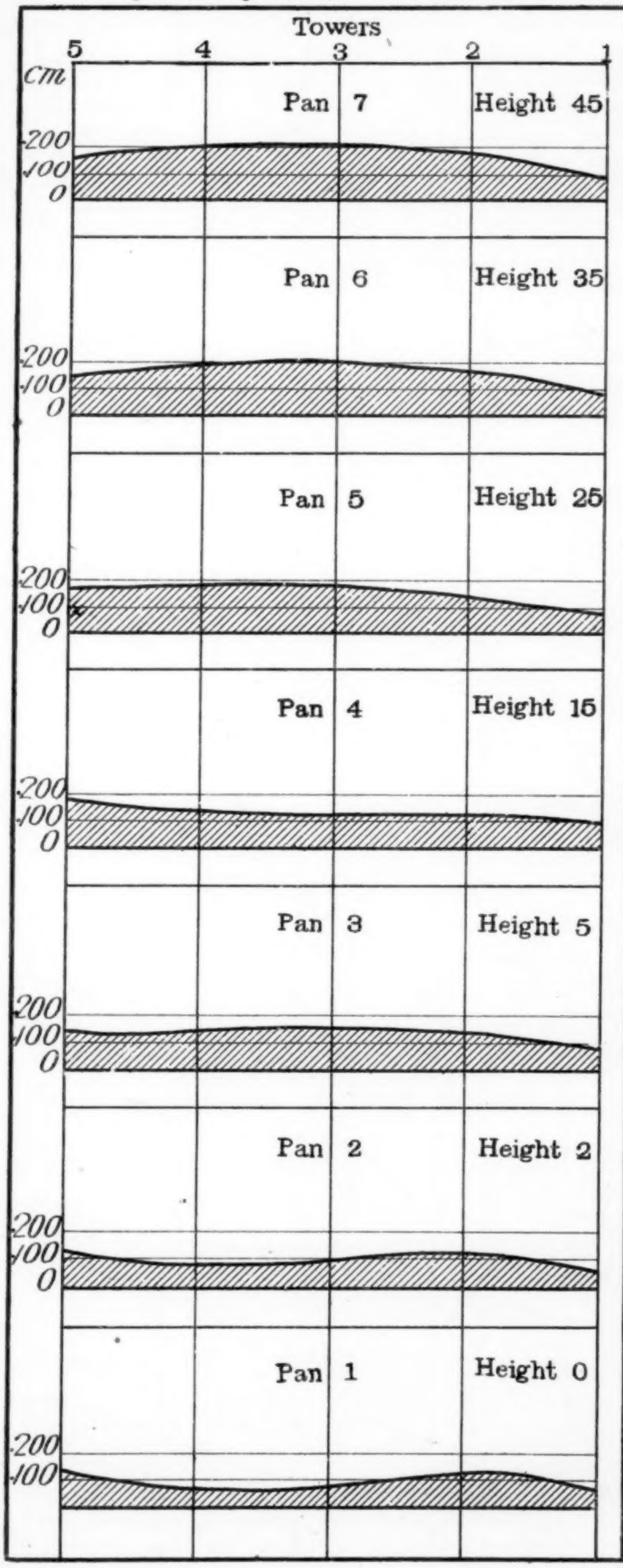

Fig. 15. Evaporation, 5 a. m. to 8 a. m.

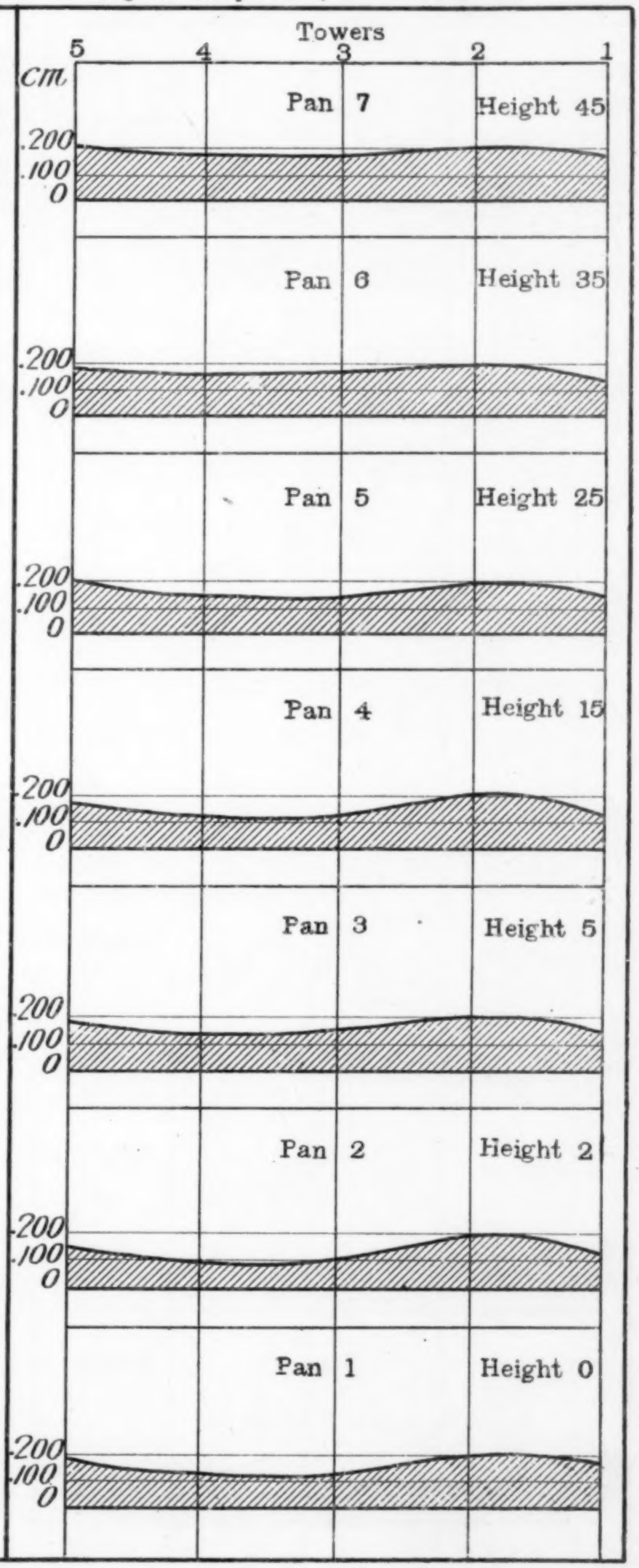

Chart XIV. OBSERVATIONS AT THE RENO RESERVOIR, AUGUST 1-10, 12-17, 1907.

Fig. 16. Evaporation, 8 a. m. to 11 a. m.

Fig. 17. Evaporation, 11 a. m. to 2 p. m.

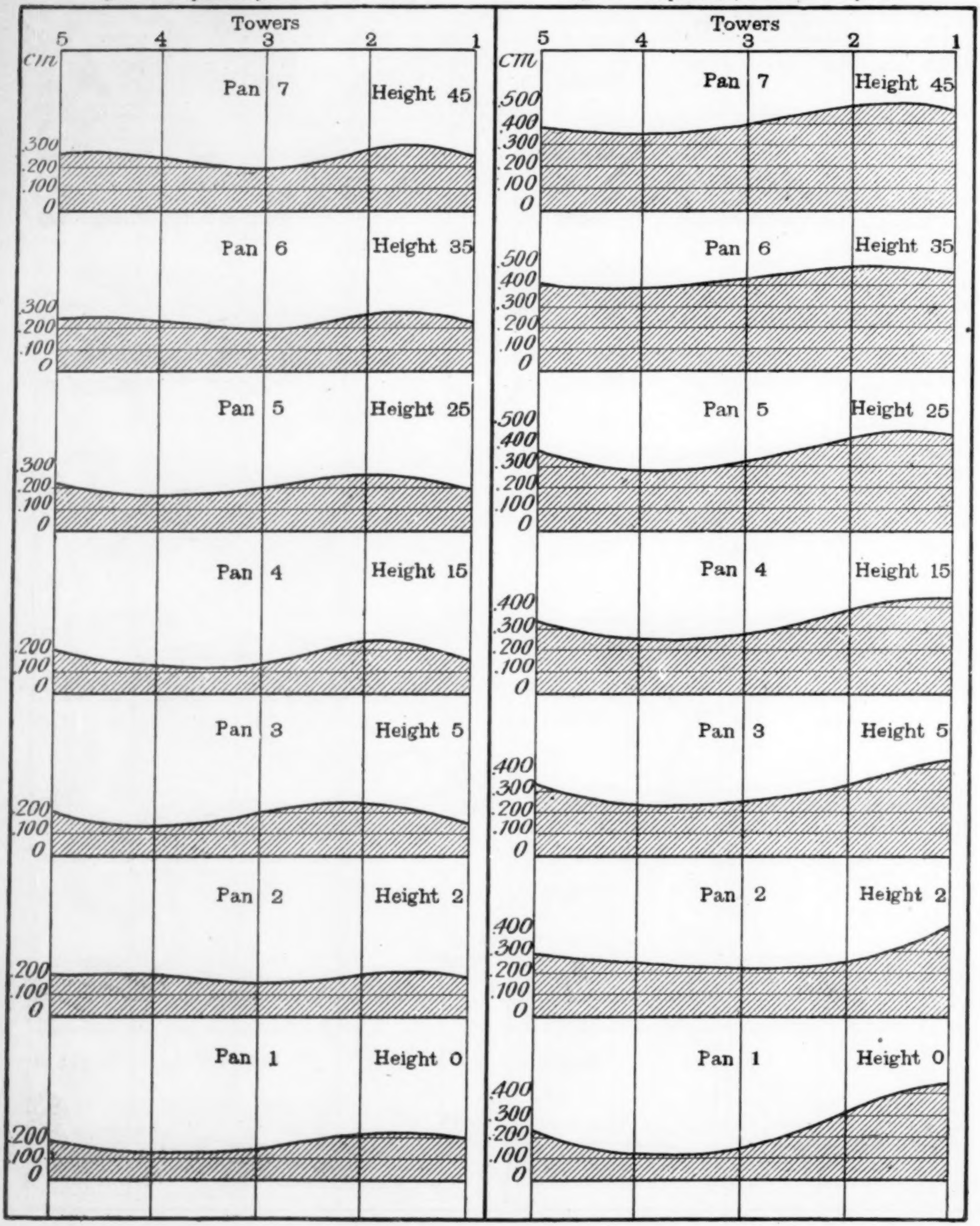

Chart XV. OBSERVATIONS AT THE RENO RESERVOIR, AUGUST 1-10, 12-17, 1907.

Fig. 18. Evaporation, 2 p. m. to 5 p. m

Fig. 19. Evaporation, 5 p. m. to 8 p. m.

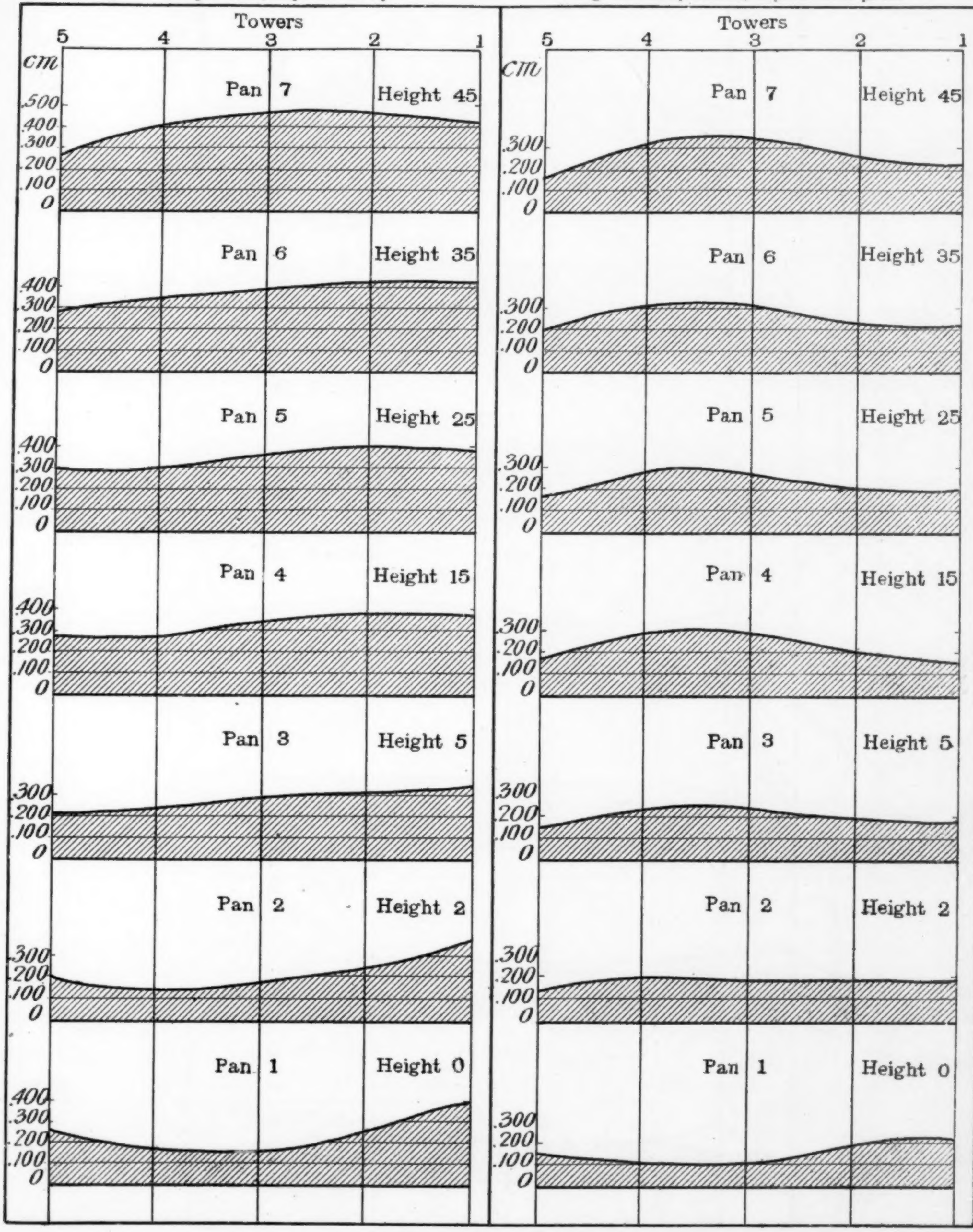

Chart XVI. OBSERVATIONS AT THE RENO RESERVOIR, AUGUST 1-10, 12-17, 1907.

Fig. 20. Total daily evapbration.

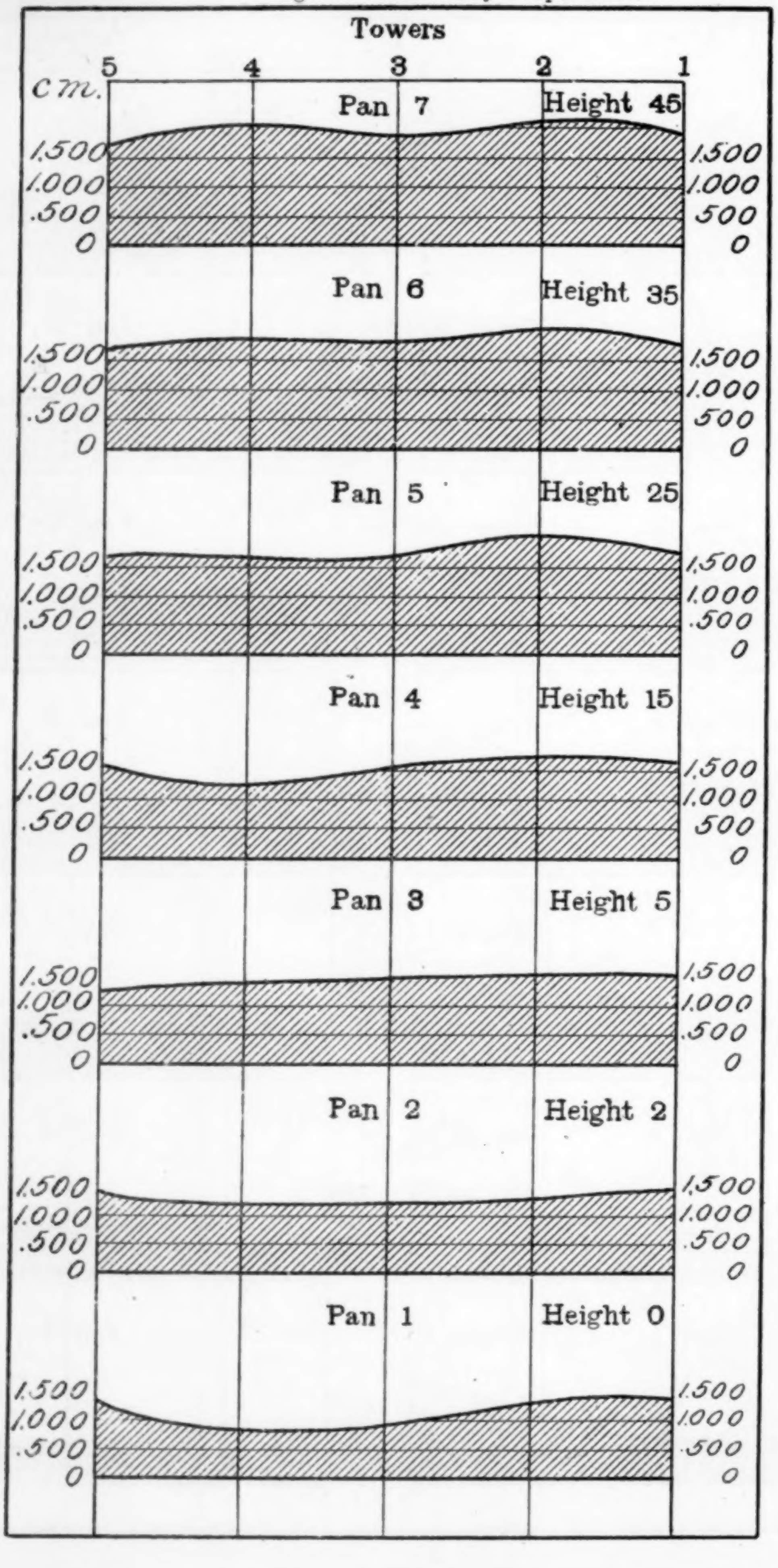

Chart XVII. EVAPORATION, E_1, E_2, E_3.

Fig. 23. Tower 1. Fig. 24. Tower 2.

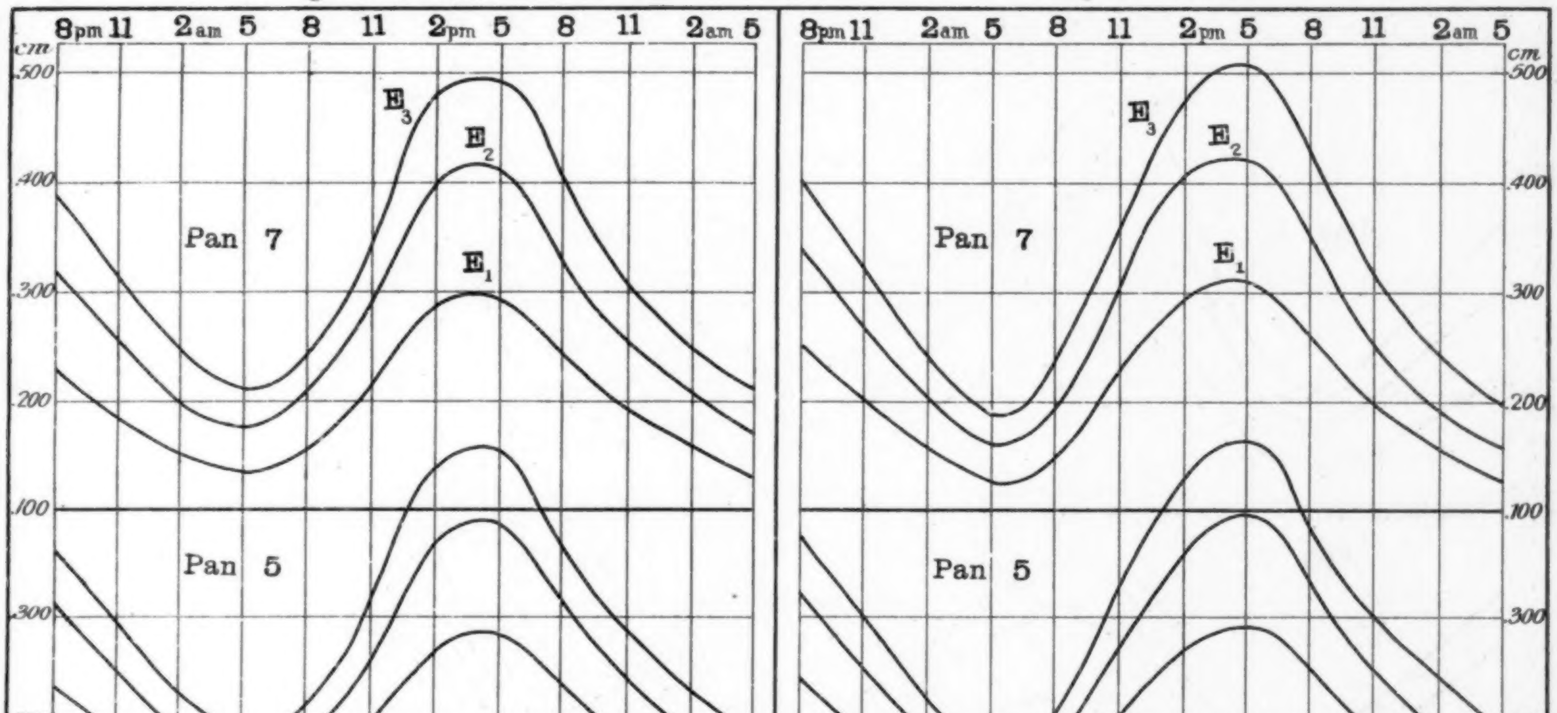

Chart XVIII. **EVAPORATION, E_1, E_2, E_3.** XXXVI.--26.

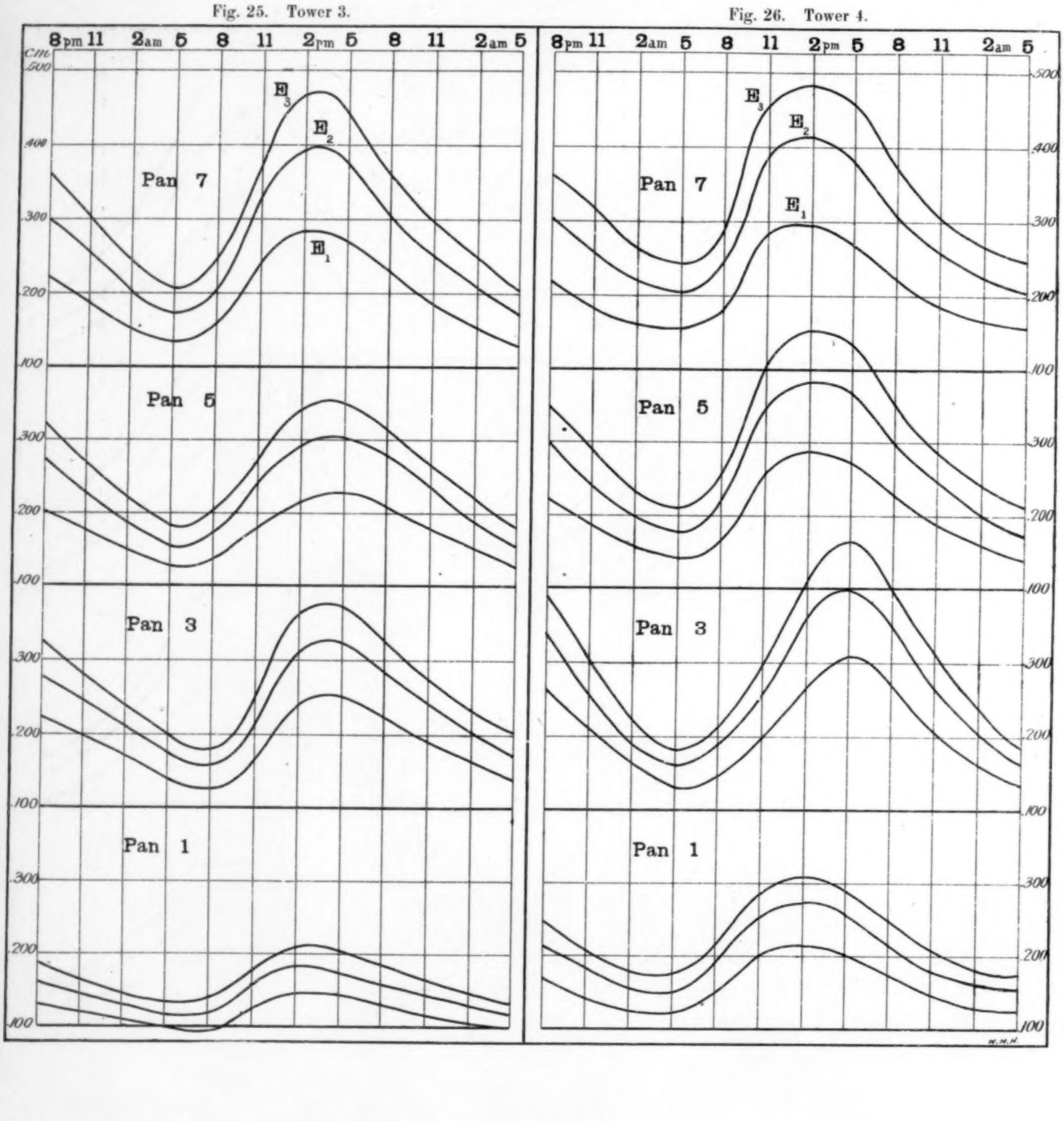

Chart XIX. EVAPORATION, E_1, E_2, E_3. XXXVI—27.

Fig. 27. Tower 5.